ORGANISATION, TECHNOLOGY AND PERFORMANCE OF IRRIGATION SYSTEMS IN UTTAR PRADESH

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NIRANJAN PANT

GIRI INSTITUTE OF DEVELOPMENT STUDIES
B-42, NIRALA NAGAR, LUCKNOW 226007

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PREFACE

The study was undertaken under ICSSR's scheme of research projects under sponsored programmes on rural development. The project work was started in January 1981 and the field work was finished by the end of 1982. Tabulation of the work took a much longer time than I had anticipated and finally it could be done with the help of Dr. PP Ghosh who was working as Consulting Statistician in the project. In this work he was helped by Mr. SK Ghosh, Technical Assistant in the Institute. I am very grateful to both of them, especially to Dr. PP Ghosh, who went out of his way to solve the data related problems. The survey work was done by a team, headed by Mr. RK Verma, who was assisted by Mr. PK Tripathi and Mr. Dinesh Singh. I wish to express my sense of gratitude to all of them for their painstaking field work. However, one person, to whom I am most grateful is Mr. Ravi Prakash Rai. He joined the project in August 1982 and has been very actively involved in multifarious kinds of works since then. Without his active involvement, it would not have been possible for me to complete the report by now.

In addition to all those who were directly responsible for the work in the project, the cooperation of a large number of informants - farmers, their representatives and officials was responsible for the completion of this study. I express my thanks to all of them. The typing of the report had to be done in a short span of time as I had to leave the Institute to take up my new assignment with USAID, New Delhi. However, the ever efficient Mr. PJ Devassykutty along with Mr. Subhasis Mukherjee completed the work in time. My thanks are to both of them.

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NIRANJAN PANT

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CHAPTER I

Introduction

Agriculture plays a vital role in the economy of India. Around 60 per cent of the total working population in India is dependent on agriculture to earn their livelihood. During 1981, 37 per cent of the total working force was engaged in cultivation and 22.4 per cent were working as agricultural labourers. This proportion was much higher earlier during 1971. In that year 43.4 per cent of the total working population was engaged in cultivation and 26.3 per cent were working as agricultural labourers (Table 1.1). It seems that this downfall is due to migration from rural areas to urban centres.

Agriculture was the highest income generating sector, contributing 47.8 per cent of the total National Income during 1971. Even during 1981, its share was highest among other income generating sectors with its contribution of 36.4 per cent at current prices and 40 per cent at 1971 prices (Table 1.2). In absolute terms it became around 2.32 times higher during 1981 in comparison to 1971.

Irrigation in Indian Agriculture started receiving vigorous weightage ever since Independence. After Independence, India faced acute foodgrain shortage and irrigation, being the most important requirement to increase production, received special attention in developmental planning. During the First Plan (1951-52 to 1955-56) the total investment on irrigation in India was Rs.456 crores which increased upto Rs.3853 crores

during Fifth Plan (upto 1978). In all, India had invested Rs.9282 crores upto 1978, since the implementation of First Plan. Out of the total investment upto Fifth Plan (1978) 58.8 per cent was spent on major and medium irrigation schemes and 41.2 per cent on minor irrigation.[1] Under minor irrigation, government funding covers 21.7 per cent and institutional finances cover 19.5 per cent of total investment on these schemes. Institutional Finance which used to have a meagre share in irrigation investment shows an increasing trend during Fourth and Fifth Plans. Institutional finance to cultivators for irrigation works increased from Rs.115 crores upto Third Plan to Rs.780 crores upto the end of Fifth Plan. Further more, irrigation received special attention during Sixth Plan (1978-83) and has Rs.10317 crores in its credit (Table 1.3).

As a result of massive investment on irrigation, its potential had also increased remarkably from 22.6 million hectares during pre-plan period to 55.87 million hectares upto the end of Fifth Plan. During the Sixth Plan the target is fixed to increase the irrigation potential by 15 million hectares.

An interesting aspect of the irrigation potential, if we examine the figures presented in tables 1.3 and 1.4, it is

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[1] Projects costing above Rs.50 million were used to be classified as major projects, while those costing above Rs.2.5 million (Rs.3 million in hilly areas) and upto Rs.50 million were termed as medium projects. Projects costing less than Rs.2.5 million (Rs.3 million in hill areas) were minor. However, according to a revised classification adopted since April 1978 the major schemes are those which have a CCA (Cultivable Command Area) of more than 10000 hectares and medium schemes are those which are having a CCA of more than 2000 hectares but upto 10000 hectares minor are those having a CCA of less than 2000 hectares.

noticeable that although the investment is more on major and medium irrigation schemes but greater irrigation potential has been created by the minor irrigation sector. As a matter of fact, development of irrigation in India, particularly during the Plan era, has been marked by two conflicting trends. On the one hand, huge investments and poor performance is noticeable in the major and medium irrigation sector, and on the other, comparatively little investments have resulted in impressive performance in minor irrigation sector. During the Plan period, upto 1980-81, 49 per cent of irrigation potential was developed through major and medium irrigation projects while about 76 per cent outlay was spent on it and minor irrigation developed 51 per cent of the total irrigation potential while 24 per cent of the outlay was invested in this sector.[1] Although minor irrigation includes both surface and ground water but in reality it is mainly ground water.

If we examine the figures presented in table 1.4, we find that there was no significant difference in the contribution of "ground" and "surface" in the minor irrigation sector upto the end of the Second Plan (1960-61). However, after that there is a progressive increase in the share of ground water and so much so that by the end of Fifth Plan (1973-74) the share of ground water becomes 72.5 per cent.

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[1] Niranjan Pant : "Major and Medium Irrigation Projects : Analysis of Cost Escalation and Delay in Completion", Economic and Political Weekly, No.26, Review of Agriculture, June 1982, p. A-42.

The same trend is visible in the Sixth Five Year Plan which proposes to invest a sum of Rs.8448.36 crores in the major and medium irrigation sector to create an additional potential of 5.7 million hectares while a sum of Rs.3516.30 crores (including Rs.1700 crores institutional investment) is to be spent on minor irrigation for creating an additional irrigation potential of 8 million hectares, of which 7 millions hectares is to be created from ground water alone. The high importance attached to irrigation sector in the Sixth Plan, can be judged by the fact that an outlay of Rs.12758 crores is earmarked to it which is a higher amount compared to Rs.12558 crores which was spent during the last thirty years (upto 1979-80).[1]

Uttar Pradesh

The economy of Uttar Pradesh like that of India is mainly dependent on agriculture. During 1971, 57.4 per cent of U.P.'s total working population was that of cultivators and 20 per cent were working as agricultural labourers. Combining them together, the total population working for agriculture comes to 77.4 per cent of total workforce. It shows that over three-fourth of working population in Uttar Pradesh, depends on agriculture to earn their livelihood. The proportion of cultivators and agricultural labourers had decreased during the year 1981. In that year, there were 53.1 per cent culti-

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[1]Sixth Five Year Plan, 1980-85, Planning Commission, Government of India.

vators and 15 per cent agricultural labourers (Table 1.5). It seems that this reduction is on account of two factors. Firstly, the Census of 1981 has a category of "marginal workers"[1] who are not classified according to work categories and are lumped together in "others" category. It is possible that many of the marginal workers are engaged as cultivators or are working as agricultural labourers. Secondly, the reduction may be on account of rural to urban migration of the village folks.

Uttar Pradesh primarily depends on agriculture for its income. Agriculture alone contributes 51.4 per cent of the total income of the state. This fact itself shows the importance of agriculture in states economy (Table 1.6).

Uttar Pradesh is the most populous state in India covering 8.45 per cent of the total geographical area of the country. Area-wise it occupies fourth position after M.P., Rajasthan and Maharashtra. In Uttar Pradesh, 43.5 per cent of the total cropped area is irrigated in comparison to all India average of 27 per cent.[2] The Plan outlays of U.P. make it apparent that Sixth Plan lays major emphasis on irrigation. During Sixth Plan it is proposed to invest Rs.1049.74 crores on major and medium schemes against the total expenditure of Rs.980.91 crores incurred upto 1979-80 under different Plans.

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[1] According to 1981 Census, marginal workers are those who worked less than 6 months or 183 days in a year.

[2] Irrigation Department : Brief Description of Work Progress, Investigation and Planning Circle - IV, U.P., Lucknow, 1983-84, p.1. (in Hindi).

The minor irrigation receives an outlay of Rs.279.96 crores during Sixth Plan against the total expenditure of Rs.442.49 crores upto 1979-80 under different Plans. Similarly, institutional investment proposed for Sixth Plan is Rs.283 crores against total expenditure of Rs.345.82 crores upto 1979-80 (Table 1.7).

During the pre-Plan period the total area irrigated by government irrigation schemes in U.P. was 26.85 lakh hectares. Out of this, 23 lakh hectares was irrigated through major, medium and minor (excluding state tubewell) irrigation shemes and 3.85 lakh hectares by state tubewell. The irrigated area under public irrigation schemes has increased to 58.53 lakh hectares upto 1979-80. Out of this 45.53 lakh hectares were irrigated by major, medium and minor (excluding state tubewell) irrigation schemes and 13 lakh hectares by state tubewells. There were 2305 state tubewell working during pre plan period which increased in each plan and reached upto 16622 state tubewells working upto the end of 1979-80. Thus, during the pre plan period the average area irrigated by a state tubewell was 167 hectares, it went down to about 78 hectares per tubewell at the end of 1979-80 (Table 1.8).

It is estimated that the number of state tubewells would increase to 21016 at the end of 1983-84. However, despite the development in its number it is worth mentioning that stagnation was observed in total irrigated area by state tubewells since fourth plan upto the end of 1979-80. While upto the end of

Fourth Plan 13 lakh hectare was irrigated by state tubewell, it remained constant upto the end of 1979-80. Further decrease of 4.97 lakh hectare is estimated in state tubewell irrigation upto the end of 1983-84. An interesting part of it is that number of state tubewells is estimated to increase by 4394 upto the end of 1983-84. Even after massive investment proposed in Sixth Plan, it is discouraging to note that the total area irrigated by the government sources upto the end of 1983-84 is estimated to decrease by 3.51 lakh hectare (Table 1.8). Contrary to this, figures presented by Ministry of Irrigation, Government of India (Table 1.9) indicate the utilization of 159 hectares more then the 1200 thousands hectares potential to be created by major, and medium schemes during the Sixth Plan. The actual figures of potential created and potential utilised upto the end of 1970-80 reveal a gap of 1088 hectares between the two. The attainment of higher utilisation as indicated in the tentative Sixth Plan is hoped to be accomplished by minimising the earlier gap (upto 1979-80) between the created potential and its utilisation. However, when the earlier created potential could not be utilised fully and there was a big gap between the two (in case of major and medium projects) there is no ground that the gap would be bridged in the Sixth Plan. Therefore, the figures given by the State Government (Table 1.8) appear to be more realistic in terms of future prospects.

Present Study

There is no denying of the fact that agricultural development has been closely linked with the expansion of irrigation facilities. Irrigation has a long history in India with consistent advancement in the knowledge concerning irrigation technology and engineering and agricultural sciences. In addition, as pointed out by us in the preceding, massive investments have been made in irrigation sector during the post-independence period. In spite of all these factors the irrigation system have been subjected to lot of criticism on account of their poor performance.

One assumption underlying this research is that the pattern of technology is shaped by, and in turn shapes the society in which this technology is generated and sustained. The other assumption of the proposed research is that the performance of an irrigation system is dependent on the interactions of the socio-economic factors with the physical and technological components of the system. For instance, the process of water distribution in a public irrigation system is a function of the physical layout of the distribution channels, technological framework and the management rules followed by the water authorities. These three elements interact and cannot be viewed as independent elements when systems are being designed or operated. Keeping in mind the underlying assumptions, the following objectives were set for the study.

Objectives

The major focus of the enquiry was four fold. One dimension of the study was the interaction among social, organizational, physical and technological factors. The second was the organizational structure and its operating procedures. The third was the issues related to farmers involvement in the water management process at the local level. The fourth was the factors which account for differential performance in different irrigation systems and suggest ways and means by which these shortcomings could be remedied. Keeping in mind these broad objectives the study was to :

1. Investigate the physical, socio-economic and political characteristics of the selected sampled areas. This involved an enquiry about the agro-economic factors like climate, soil, topography, cropping pattern, intensity of cropping, use of inputs and innovations, productivity; the socio-economic characteristics of the farming communities like population density, social structure, land distribution and land relations, irrigation experience and agricultural practices.

2. To study the existing and available irrigation technologies in sampled areas and appropriateness of these technologies in terms of agro-economic, financial and technical requirements and social justice, particularly to small farmers. The appropriateness of a given technology was to be examined not only in terms of its technical efficiency but also its consistency with the socio-economic requirements of the society where it operated. Thus, the technologies of various water resources

like canals, tubewells, wells and tanks, and technologies of various power sources like manual, wind, animal, electric, solar and diesel motors were to be examined in terms of social and physical settings. One of the major thrusts of the enquiry was to examine whether improved indigenous irrigation technology, based on local operation and maintenance competence could be utilized for better and greater agricultural productions or it would create obstacles in the efficient utilizations of water.

3. To study the structure and operating procedures of irrigation management at various levels. Operations of the irrigation programme and relationship among different components related to the success of the programme were to be studied in considerable detail. Special attention was given to highlight the organizational and management problems at the field level. This included coordination between different agencies (like Block, Irrigation Sub-Division and Revenue Circle), departments (like Irrigation and Agriculture) and services (like ground water and surface water), relationship between the headquarter and the field agencies, extent of decentralization and its consequences and, effectiveness of various units in relation to their objectives.

4. To investigate the structure of organization through which farmers participate in the water management process. In this connection some of the issues related to water user's associations like utilization of indigenous social organizations for better water management and increased popular participation at the local level; size, functions and boundaries of irrigation

farmers' organizations; membership, voting rights, tenure and mode of selection of office holders in these organizations; and utility of these organizations in terms of effective implementation of the policy decisions like, strict enforcement of cropping pattern and rotation system of water distribution were to be examined.

5. To identify, in terms of distribution of irrigation benefits, the real beneficiaries and the socio-economic grouping of the local area they represented.

The Universe

Keeping in view the broad framework and the objectives of the proposed research, Uttar Pradesh was selected as the universe of the study. The choice of U.P. was guided mainly on account of the fact that U.P. is the largest state of India with maximum irrigation potential and huge public investment in this sector. In addition it provides existence of a variety of irrigation systems. From the point of view of irrigation zones, U.P. can be divided into following three parts.

I. The Hill Region : It comprises of the districts of Uttar Kashi, Chamoli, Pithoragarh, Tehri-Garhwal, Garhwal, Almora and parts of Nainital and Dehra Dun districts. High mountains, formed of sedimentary rocks broken by valleys and deep gorges, characterise the terrain. The hill areas are sparsely populated and communication is difficult and large areas are inaccessible. Due to the excessively slopy nature of the terrain, soil is

subject to heavy erosion. Cultivation is done under intensive soil and water conservation methods with an afforestation programme in the upper reaches. Because of the geography of this area it is not feasible to provide irrigation facilities to the whole area. Before the plan period there was no provision of irrigation on the part of the government. Recently an irrigation programme has been launched by the government in this region under which hydrams/sprinklers, kachcha and pucca goals (channels); canals and water tanks are being provided in this areas.

II. Southern Region : It is demarcated by the Vindhya hills and plateau. It comprises the five districts of Bundelkhand division and Mirzapur district and parts of Allahabad and Varanasi districts. The ground is strong with low hills at places. The Betwa and Ken rivers join the Jamuna from the south-west in this region. It has four distinct kinds of soil, two of which are agriculturally difficult to manage. Only one of these soils lends itself to easy cultivation. Rainfal is scanty and erratic and water resources are scarce. Rainfed reservoirs are the major source of irrigation. Dry farming is practiced on a large scale.

III. Gangetic Plain : It stretches across the entire length of the state from east to west, flanked by the Terai and Bhabhar areas in the north and the Vindhyan plateau in the south. The entire alluvial plain can be divided into three sub-regions. The first is the eastern tract which is subject

to periodical floods and droughts and has been classified as a scarcity area. It has the highest density of the population (855 per quare mile) which gives the lowest per capita land (1.42 acres). The other two regions, the central and the western are comparatively better off with a well-developed irrigation system. These two regions, however, suffer from water-logging and large scale infertile tracts.

The Gangetic plain is watered by the Jamuna, the Ganga and its major tributaries, the Ramganga, the Gomti, the Ghaghra and the Gandak. The whole plain is alluvial and very fertile. Agriculture has been practiced here since ages. About 70 per cent of the area is cultivated. The chief crops are rice, wheat, millets, gram, barley and sugarcane, the last being the chief cash crop of the region. The major means of irrigation are canals, wells and tubewells (private and public).

The study has been confined to the Gangetic plain region of Uttar Pradesh. The other two regions, Bundelkhand and Hill were left out on account of two reasons. The first, to keep the universe of the study to a manageable level. The second, these two regions have very little irrigated agriculture. On account of geo-hydrological and geographical constrains the most commonly practiced agriculture is rainfed. On the contrary, Gangetic plain contains areas with most developed agriculture as well as a variety of irrigation systems - the oldest and largest canal systems in India as well as the most traditional irrigation systems. Keeping in view the objectives of the study, three districts representing the three regions of

the part of Gangetic plain covering Uttar Pradesh were chosen for a detailed investigation at the first instance. The three districts selected for the study were Meerut, Barabanki and Deoria. Meerut is the most representative district of the Western region. With an intensity of irrigation of 122.98 per cent it ranks first in U.P. In addition, from the point of view of historical linkages Meerut is served by the Upper Ganga canal system which is one of the oldest canal systems in India. Barabanki forming part of the Central region is covered by Sharda Sahayak irrigation project which is one of the largest project in India with a Command Area Development Agency (CADA). Deoria which has been chosen from the Eastern region is under Gandak CADA enabling us to compare the two CADAS, covering the districts of Barabanki and Deoria. In addition, the study of Meerut and Deoria, representing two contrasting zones, particularly, in terms of agricultural development, was also thought to be important from the point of view of the appropriateness of prevailing irrigation modes and their technology in the two region.

The three regions of the Gangetic plain as mentioned in the preceding show a wide range of inter-district disparities in levels of development. Most of the districts falling in western part of the plain have attained high level of development and Meerut, one of the selected districts of the study stands first (with the highest composit index value of 2.4685) in hierarchical level and pattern of development. Moreover, the districts falling in the central part of the plain have

attained either medium high or medium low level of development. Barabanki, the other district selected for the study although occupies its position in the medium low category, but is found to be much closer to the category of medium high level of development. Besides, excepting Gorakhpur, Varanasi and Allahabad, a considerable number of districts constituting eastern portion of the plain occupy their position in the category of medium low level of development and Deoria is one such districts. Although Barabanki and Deoria both fall in the category of low level of development, the value of composit index of development for the former is found to be much higher (0.3661) as compared to the latter (0.2910).[1]

Methodology

The study was conducted both at macro and micro levels. At the macro level, most of the data were collected from secondary sources like official records and other published material. Detailed interviews were also be conducted with government officials, public representatives and other knowledgeable informants to supplement the data. At the micro level investigation was conducted at the selected sampled areas from each of the three regions of the Gangetic plain of U.P., which have been described in the preceding.

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[1] R.T. Tewari : District-wise Pattern of Development in Uttar Pradesh, Giri Institute of Development Studies, Lucknow, 1983, pp.128-130 (Mimeo).

The techniques of the case study as well as the survey were utilized for data collection. The case study approach was utilized for an indepth study of the operation and management of various irrigation systems at the field level. The survey method was for obtaining information on social, ecoomic and agricultural aspects, like pattern of land holding, cropping pattern, use of inputs and innovations, and production and productivity, etc.

At the outset three large scale canal irrigation projects commanding the three districts were chosen. So, Upper Ganga Canal system was studied in Meerut district. Sharda Sahayak was taken to cover Barabanki and Gandak system was examined in Deoria district. Two of these irrigation projects, as mentioned in the preceding, were CADA projects while Upper Ganga was a non CADA project. In the next stage we took three villages from each district. Two of the villages from each districts were to be commanded by that large scale canal project which we had earlier chosen. Of the two villages, one was to be at the head reach and the other at the tail end of each of the three irrigation project. Thus in all, we chose three head reach and three tail end villages. In addition, from each district we chose a village commanded by a State Tubewell. We expected and did find lots of private tubewells and traditional irrigation modes in tail end and State Tubewell commanded villages. This helped us in forming four single categories of irrigation systems (canal, State Tubewell, Private Tubewell and Traditional) and six combinations of these single systems.

The nine villages so selected were of medium size with 150 to 200 households. The household was treated as the basic unit of our study and all survey data were collected at the household level. In the first stage a preparatory survey of all the household is in a tentatively selected village was conducted. It contained the name of each of the head of the household and information about his caste, age, educational status, occupation, agricultural land and sources of irrigation employed by him. The final selection of a village was done if it met all our requirements. A large number of villages had to be rejected after the preparatory survey and the new replacements in their place were made where again a preparatory survey was done. Since the main concern of our study was issues and questions related to irrigation, in the final selection of households, all landless people and all those who had less than 0.5 acres of land were dropped from each village. This also facilitated a manageable sample size from each village. The average sample households from the nine villages came to 96.4, the smallest having 84 households and the largest with 108 households. The total number of households surveyed were 868. Of these, 300 were taken from Deoria, 283 from Barabanki and 285 from Meerut districts. A detailed interview scheduled was formulated to elicit the required information from the sample respondents. The survey was conducted under the supervision of the Project Director by one Research Assistant and two Field Investigators during June-September 1981. However, many more visits were made to the field areas at later stages by the Project Director and the Research Assistant to collect relevant information concerning the study.

The Three Districts : Meerut, Barabanki and Deoria

The three districts under study, namely, Meerut, Barabanki and Deoria, fall in the Western, Central and Eastern regions of the State of Uttar Pradesh respectively. Though placed in different parts of the state, they all form part of the fertile Gangetic plains. The district of Meerut lies between 23° 30' north latitude and 70° 79' east longitude. It is bounded on the east by the districts of Bijnor and Moradabad, on the west by the state of Punjab and Delhi, on the north by the district of Muzaffarnagar and on the south by the district of Bulandshahr. The soil of the district is Indo-Gangetic alluvium which can be divided into three main categories : 'khader', 'kankar' and 'ret'. The main rivers passing through the district are Ganga, Yamuna, Boorhi Ganda, Kali, Krishna and Hindon.[1] The various administrative headquarters of the district are situated in the city of Meerut which also houses the divisional headquarters of the Meerut Division. The civil administration of the district functions under the District Magistrate, Sub-Divisional Magistrate and 'Tehsildars'. So far as the development work in the district is concerned, it falls under the domain of the District Development Officer who is assisted by district level subject matter specialists such as District Animal Husbandry Officer, District Agriculture Officer, etc. At the block level, these works are looked after by the Block Development Officer.

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[1] Primary Census Abstract Meerut, 1971, part XB, p.vi.

The city of Meerut is well connected by roads and railways with the rest of the state as well the country. It is divided into 4 Tehsils and 18 blocks.

The district of Barabanki lies to the east of Lucknow and west of the Faizabad Division. It lies between the parallels of 27° 19' and 26° 30' north latitude and 80° 58' and 81° 55' east longitude. Except a small portion which lies to the south of Gomti, the district forms a part of the tract that lies between Gomti and Ghagra rivers. It is bounded by the districts of Lucknow on the south-west, Sitapur on the nort-west, Bahraich and Gonda on the north and nort-east, Faizabad on the south-east, and Rae-Bareli and Sultanpur on the south. The various administrative headquarters of the district are located at Barabanki which is well connected by roads and railways with the state capital of Lucknow. The administrative structure of the district is the same as that of Meerut. It is divided into 4 Tehsils and 16 Blocks. Ghagra and Gomti are the main rivers of the district. Ghagra forms the northern boundary of the district, separating from Bahraich and Gonda. The main tributary of Ghagra is Chanka which is also known as Sharda.

The district of Deoria falls in the extreme eastern part of U.P. It is a relatively new district which was carved out of the district of Gorakhpur in 1946. The need to make it a separate district was felt as back as in 1909

on account of its developing economic activities.[1] It falls in the Gorakhpur division in its north-eastern portion. It lies between the parallels of 26° - 28° north latitude and 83° - 85° east longitude. It is bounded on the east by the Champaran district of Bihar, Balia and Azamgarh districts in the south and Gorakhpur district in the West. The various administrative headquarters of the district are situated at Deoria which is connected by railways and roads with the rest of the state. Great Gandak, little Gandak, Ghagra, Rapti and several other rivers flow through the district.[2] The administrative structure of the district is similar to that of other two districts mentioned in the preceding. The district is divided into 4 Tehsils and 25 Blocks.

The three districts together account for about 4.62 per cent of the total geographical area of the state and about 7.45 per cent of its population. They are very densely populated. Thus, as is shown in Table 1.10, the density of population per square kilometer amounts to 708, 453 and 642 in Meerut, Barabanki and Deoria respectively as against the state average of 377. The economy of these districts is predominantly rural and agricultural. The percentage of urban to total population stands at 31.22, 8.92 and 6.63 in Meerut, Barabanki and Deoria respectively against the state average of 17.95. Thus, excepting Meerut, these figures are much lower

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[1] Gorakhpur : A Gazetteer being Volume XXXI of the District Gazetteer of United Provinces of Agra and Oudh, 1909, p. 221.

[2] Primary Census Abstract, Deoria, Part X-B, 1971, p.vi.

than that of the state. Similarly the work force engaged in agricultural sector (cultivators and agricultural labours) account for about 55.72 per cent, 86.55 per cent and 83.87 per cent of the total work force in the districts of Meerut, Barabanki and Deoria respectively against the state average of 74.55 per cent. In this also, only in the case of Meerut the figure is lower than the state average. These districts depict large variations in their rates of literacy. As is evident from Table 1.10, while this rate exceeds the state average (27.16) in Meerut (34.68), it falls short in Barabanki (18.87) and Deoria (23.20). The number of female per thousand of male population is the highest in Deoria (988) and the lowest in Meerut (838). The high figure in Deoria reflects its surplus labour character and migration of labour to other places in the state as well as the country. To some extent, the low figure in Meerut reflect in-migration of labour from other areas.

On account of heavy pressure of population as also on account of its plain topography, most of the land of these districts is under cultivation. As is evident from Table 1.11, the percentage of the net sown area to total geographical area amounts to 79.45, 65.16 and 82.61 in Meerut, Barabnki and Deoria respectively. These figures are not only very high but also exceed the state average (57.91) by a very high margin. For the same reason, the average size of holding is very small. It amounts to 1.39 hectare in Meerut, 0.82 hectare in Barabanki and 0.76 hectare in Deoria. Thus, except Meerut, this figure

is smaller than the state average of 1.18 hectare. The same thing is to be found with the net sown area per cultivator. This figure is smaller than the state average, except in the case of Meerut where it slightly exceeds the state average.

The consumption fertilizer per hectare of the sown area amounts to 106.81 kg. in Meerut, 51.84 kg. in Barabanki and 72.49 kg. in Deoria. These figures are higher than the state average of 51.66 kg. The figure is more than two times of the state average in Meerut. The gross irrigated area as percentage to the gross sown area comes to 87.57, 42.79 and 48.21 in Meerut, Barabanki and Deoria respectively against the state average of 46.33. Thus, while this figure slightly falls short of the state average in Barabanki, it is much higher in Meerut.

Table 1.12 contains data on the distribution of net irrigated area according to the source of irrigation. Like that in the state as a whole, these districts too depict predominance of canals and tubewells as the main sources of irrigation. The districts, however, depict more predominance of canal irrigation as compared to the state. Meerut is the only exception in this regard where the share of canals (32.96%) slightly falls short of the state average (33.63%). On the other hand, these areas depict less predominance of tubewells. Again, Meerut is an exception in this regard where tubewells account for 65.71 per cent of the irrigated area which significantly exceeds the state average of 53.45 per cent. On

account of relatively better irrigational facilities as also heavy pressure of population, these districts depict high intensity of cropping. The cropping intensity (defined as the total cropped area as percentage to the net cropped area) comes to 161.41 in Meerut, 153.71 in Barabanki and 146.87 in Deoria. These figures significantly exceed the figure for the whole state (142.69).

Some elements of modernisation of agriculture have been shown in table 1.13. The number of tractors per thousand hectare of the sown area amounts to 15.11 in Meerut and 3.58 in Deoria. These figures are higher than the state figure of 2.5. The number of electric pumpsets per thousand hectare of the sown area comes to 68.06 in Meerut which is much higher than the state average of 17.5 per cent. On the other hand, these figures are much lower in Barabanki (10.58) and Deoria (10.51). The same trend is to be observed in the field of rural electrification. The percentage of the electrified villages amounts to 65.47 in Meerut which significantly exceeds the state average of 45.53. On the other hand, these figures are on a very low side in Barabanki (32.18) and Deoria (34.98). The per capita consumption of electrifity is treated as a very important index of development of a region. The per capita consumption of power per annum comes to 130kwh in Meerut which is higher than the average for the state (90 kwh). This figure is very low in the other two districts, with 30 kwh each.

From the above account, it is amply clear that among the three districts, the district of Meerut emerges out to be the best in terms of agricultural infrastructural facilities, such as, irrigation, electrification, tractorisation, etc. These are reflected in the value of agricultural output per unit of the sown area. As is shown in table 1.13, the gross value of the agricultural produce per hectare of the net sown area during 1978-79 amounted to Rs.4676 in Meerut, Rs.3449 in Barabanki and Rs.3262 in Deoria. All these figures exceed the state average of Rs.2919. A similar trend is to be observed in respect of the value of net domestic product per capita. This figure comes to Rs.710 in Meerut which is not only the highest among the three districts but also exceeds the state average of Rs.598. In the district of Deoria, however, this figure (Rs.454) falls short of the state average but is highest in case of Barabanki (Rs.615). We get the same trend when we examine the productivity of some important crops. As is shown in Table 1.14, paddy, wheat and sugarcane constitute three important crops both in the state as well as in these districts. These crops together account for over 60 per cent of the total cropped area in U.P., 66 per cent in Meerut, 71 per cent in Barabanki and 83.22 per cent in Deoria. The relative importance of these crops, however, varies from district to district. Wheat happens to be the most important crop followed by paddy in the state as a whole as well as in Barabanki. In Deoria, however, paddy happens to be the first important crop followed by wheat. On the other hand, wheat

happens to be the most important crop in Meerut followed by sugarcane. In fact, the area under sugarcane in Meerut (28.84 per cent) is only marginally less than that under wheat (33.47 per cent). Thus, while sugarcane and wheat come out to be the two important crops in Meerut, wheat and paddy come out as first two important crops in Barabanki and Deoria. The productivity of paddy per hectare comes to 13.81, 11.40, 11.00 quintals in Meerut, Barabanki and Deoria respectively. These figures exceed the state average of 10.53 quintals. Among the three, the productivity is highest in Meerut. The productivity of wheat per hectare amounts to 22.89, 14.91 and 16.63 quintals in Meerut, Barabanki and Deoria respectively against the state average of 16.50 quintals. While the productivity exceeds the state average in Meerut and Deoria, it falls short in Barabanki. The productivity in Meerut exceeds the state average by a very big margin (38.73 per cent). The productivity of sugarcane per hectare comes to 541.42, 363.72, 423.64 and 470.90 quintals in Meerut, Barabanki, Deoria and U.P. respectively. Thus, while this figure exceeds the state average in Meerut by 15 per cent, it falls short of the state average in Barabanki and Deoria by 29 per cent and 11 per cent respectively.

Organisational Structure

Development of irrigation, including flood control are state subjects under the constitution. Therefore, the basic responsibility for implementation of irrigation schemes rests with the State Governments. The central government plays a

catalytic role in formulating national programmes, coordinating the nation-wide efforts, providing high level technical assistance to state governments and undertaking important key observations and studies on a national basis and bringing new technology innovations to the notice of state level implementation agencies in order to move towards higher precision and efficiency.

The major part of government irrigation programme is channelised through the State Irrigation Department and the Command Area Development Agencies.

Irrigation Department

The department is headed by a Cabinet rank minister who is a politician. He has overall authority for all areas encompassed by the department and is directly responsible to the Cabinet of which he is a member, and to the State Legislature. The next position in the hierarchy is occupied by the Irrigation Secretary. He is a career bureaucrat and is a generalist administrator of Indian Administrative Service (IAS). Below him are two Special Secretaries, one an IAS and the other an engineer. The engineer Special Secretary is junior in rank to the Engineer-in-Chief who heads the technical wing of the Irrigation Department. The Engineer-in-Chief is a technocrat incharge of overseeing the technical and implementation aspect of various major and medium irrigation projects and State Tubewells. At the project level Chief Engineers are overall incharge of the project.

In Uttar Pradesh, there are 28 Chief Engineers (CEs) and one Director of Engineers' Training Institute who is also of Chief Engineer's rank. All the project CEs with the exception of Ganga and Central Ganga are posted in Lucknow, the State capital. Out of 28 CEs, 13 are directly involved with different canal irrigation projects, 4 are connected with tubewell irrigation, 5 with research planning and evaluation, 3 with design and one each with material management, hydro electricity and water management. Each CE has under him 4 to 5 Superintending Engineers(SEs) whose jurisdictions are termed as "circles". There are 175 SEs in U.P. of which 139 head the "circles" of the same number in the State Irrigation Department and the rest of them work as Personal Assistant (PAs) to CEs or in some other capacity. Each "circle" consists of 4 to 5 Divisions, each headed by an Executive Engineer (EE). In all, there are 552 Divisions in U.P. The jurisdiction of a circle is decided on the basis of its distance from the Divisional headquarter. The distance should be such that it is accessible to each Divisional incharge. The various units of administration below Division are Sub-Divisions and sections. These units are headed by Sub-Divisional Officers (Assistant Engineers) and Overseers/Junior Engineers) respectively. As regards the number of smaller units under each bigger unit, there is no definite criterion. Their number is determined on the basis of the amount of work to be done and the funds available for that work.

The division is the most important administrative unit in the set up of engineering service. It is at this level where most of the field level construction programmes are implemented. The EE, who heads the Division, is responsible for the maintenance of the canal system, distribution of water and realisation of water rates. All the schemes concerning canal irrigation and pertaining to his jurisdiction are passed and sanctioned by him. All payments to contractors are made from his office. In the irrigation maintenance set up, the Division palys the key role. The distribution of water in a canal system is made by the concerned CE amongst the various circles. In their turn, the SEs allocate the share of water for each Division. The EEs, thereafter issue detailed regulation orders for the opening or closing of the canal and the distribution system under them.

The EE is assisted by three to five SDOs and one Deputy Revenue Officer (DRO). While the SDO is a technical graduate, the DRO does not possess any technical qualification and is head of the irrigation revenue hierarchy. In U.P., the assessment of water rates is done by the Irrigation Department and collection by the Revenue Department. Next to the DRO is the Ziladar who is directly under the control of the canal SDO but the Ziladar is also responsible to the DRO for irrigation revenue matters. Under each Ziladar, there are Amins and canal patrols to record the irrigated crops, help in maintaining the irrigation discipline, report unauthorised practices by the cultivators, detect and report wastage of water by the culti-

vators and allied matters. Normally the jurisdiction of one patrol spreads over a command area of about 1500 to 2000 acres.

The irrigation department is also responsible for the development of ground water through State Tubewells which are used both for direct irrigation and feeding water in the canals. There are four CEs to do this job. The one is designated as CE State Tubewell (East) and is headquartered in Lucknow. There are five "circles" under him - two at Varanasi and one each at Gorakhpur, Jaunpur and Gazipur. The second one, CE StateTubewell (Central), is also headquartered at Lucknow. There are four "circles" under him located at Allahabad, Kanpur, Jhansi and Faizabad. The third one, CE State Tubewell (West) is headquartered at Meerut. There are five "circles" under him at Meerut, Aligarh, Moradabad, Bareli and Agra. The fourth one, CE World Bank, Public Tubewell, is headquartered at Lucknow. There are four circles under him - two at Lucknow and one each at Kanpur and Aligarh. The World Bank pilot scheme with 500 such tubewells was started from April 1980 in 12 districts of the state. The supposed success of this pilot experiment has earned India a 35.3 million dollar loan from the International Fund for Agricultural Development (IFAD) to finance the second tubewell project in U.P., involving installation of 2200 tubewells and upgrading of 750 existing tubewells, benefiting about 440,000 families in 20 districts, three of which were also in phase one.

Command Area Development Programme

The CAD Programme was initiated in 1974-75 as a centrally sponsored scheme. The primary objective with which the programme was initiated was to bridge the gap between the created irrigation potential and its utilization and to make the best use of the available land and water resources to increase agricultural production. Two important components of the CAD programme were : (i) improvement of water delivery and drainage systems and the execution of land levelling and land shaping works; (ii) formation of unified organization with direct line of command over the personnel of Irrigation, Agriculture, Soil Conservation and Cooperation department so as to obtain adequate coordination to the required work in an integrated manner.

However, the performance of CADAs in several states has shown two clear trends : (i) the agency could never obtain the adequate powers to control the functioning of the other departments mainly because the departments did not like to part with the monopoly of their powers over their personnel. (ii) Attachment of high importance to completion of physical links and fixing of high targets for the construction of field channels and other on-Farm Development (OFD) activities. As a matter of fact, CAD programme in operational term means improvement in the delivery system below the 'chak' (outlet). This has led state governments to lay total emphasis on construction work pertaining to OFD and complete neglect of other institutional solutions. As a result, the programme has failed in

achieving its objectives mainly because the whole problem of water delivery and distribution has been treated by the policy makers and its executors as a problem of technical imperfections in the delivery and distribution systems. Therefore, the strategy which has been evolved is heavily weighted in favour of technical solutions underscoring the importance of other factors, particularly the institutional ones, like the operational procedures of irrigation bureaucracy and farmers' participation. In addition, the new policies of the Union Government concerning the financial arrangements for OFD works has given the CADA engineers and other staff a free licence to incur expenditure pertaining to OFD works without any kind of checks and scrutiny of the work.

Initially the CAD Programme was initiated in 50 projects, 10 more projects were added between April 1978 and August 1979 and 16 project were included in August 1979 and thus the programme at present covers the commands of 76 projects located in 16 States and 1 Union Territory.[1] In U.P. under the provisions of Uttar Pradesh Area Development Act, 1976, the U.P. State Government constituted three Command Area Development Authorities to cover three large scale canal projects namely, Sharda Sahayak, Gandak and Ram Ganga irrigation projects (the first two form part of our study).

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[1] K. Ramanujam : Nine Years of Command Area Development, National Seminar on Impact of Command Area Development Programme on Land and Water Productivity and Economy of the Command Areas, Technical Presentations, Volume I, Government of Uttar Pradesh, November 1983, pp.1-20.

At the state level there is a Water Utilisation and Command Area Development Committee headed by the Chief Minister. A Special Secretary of the Command Area Development Department supervises the work of CAD in Uttar Pradesh. Policy formulation and review of CAD Programme in U.P. is main task of the Secretariat level organisation. They also effect coordination at State level with the connected departments like irrigation, cooperatives, Revenue, etc.

At the project level the chairman of the authority is a senior level official of the rank of a Commissioner who is also the Administrator for the CADA project. The Deputy Administrator, who is again an IAS is also the Secretary of the Authority. The project level structure has four divisions. First, the Administrative Division, headed by the Deputy Administrator. Second, the Agronomy Division, headed by an Additional Director, Agriculture. Third, the Resource Division, headed by an Additional Registrar of Cooperative Societies. Fourth, the Animal Husbandry Division, headed by an Additional Director of Animal Husbandry.

At the field level, the organisation is geared to take up OFD works primarily. OFD measures are planned and executed by the Soil Conservation units transferred from the Agriculture Department. In case of Sharda Sahayak, 27 such units, supervised by Deputy Directors (Soil Conservation) were already in position. 20 new Soil Conservation and 3 Deputy Directors were included during 1978-79. The work of these units is

supervised by the Additional Director of Agriculture assisted by the two Deputy Directors and a Specialist at the Project Headquarters. Every unit is headed by a Bhoomi Sanrakshan Adhikari (BSA)/Soil Conservation Officer, one Technical Assistant, 2 Overseers, 5 Soil Conservation Inspectors (SCIs) and 25 Assistant Soil Conservation Inspectors (ASCIs). Survey, planning and execution are done by this unit in "kulaba" (outlet) commands allotted to it.

The U.P. Area Development Act, 1976, which created three CAD Authorities in U.P., has made provision for irrigation farmers' organisation at the "kulaba" level. The "chak sabha" consisting of all the land holders in an outlet command "shall be owner of all works constructed for land development of the outlet command" (sec. 22). The "chak sabha" elects five members from amongst themselves to be members of "chak samiti" with a chairman and a Secretary-cum-Treasurer (sec. 23). The functions of the samiti are, maintenance of outlet system, carrying out "Osrabandi" and implementation of physical works of land development and cropping in the outlet command (sec. 24). The "chak sabha" begins to work after the outlet area is handed over by the Irrigation Department to CAD Authority. The farmers of the outlet are supposed to meet, discuss and approve the OFD plan for the command area with the beneficiary farmers. The beneficiary farmers are involved in general assistance to the soil conservation staff engaged in the land development activity.[1]

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[1] R.C. Tripathi : Farmers' Participation : The Sharda Sahayak in Utilisation of Canal Waters : A Multi-Disciplinary Perspective on Irrigation, edited by K.K. Singh, Central Board of Irrigation and Power, New Delhi, April 1983, pp.58-59.

The Three Canal Systems

Upper Ganga Canal System : The canal system, one of the oldest and largest in the country is not covered by the CADA programme. The system occupies the western part of the Ganga plan. The canal takes off from the right bank of river Ganga at Hardwar from a diversion weir. The work on this canal was started in 1837-38 and irrigation commenced from 1854. The work on this canal was taken up as a result of severe famines in the earlier years, therefore, it was designed to provide protective irrigation against famines and droughts.

The gross command area of the canal system is about 2 million hectares and the system extends over 200 miles. It has three branch canals namely, Mat, Deoband and Anupshahar (our sample villages fall in the command of this branch). The initial criterion in constructing the canal was to provide protection for rabi crops. Gradually, the kharif crop also developed with pressure of population on land. Gradually the need for irrigation has been increasing on this canal so much so that all the non-monsoon supplies are being utilised for irrigation for a very long time. The scope, therefore, for increase in irrigation is during the monsoon period only. As a matter of fact, to provide additional irrigation during kharif, modernisation of all the three branches is in progress which would give 51340 hectares of additional paddy irrigation. It is estimated to cost 32.30 crore rupees. By the end of 1982-83 already 9.56 crore rupees had been spent on the scheme. In case of Anupshahar branch alone 11.74 crore rupees are

estimated to be spent and by the end of 1982-83, of which 3.44 crore rupees had already been spent. Anupshahar is the main branch canal of the system. It takes off at 50.3 miles from Upper Ganga Canal. Paddy irrigation in its command is confined to 2.6 per cent of the CCA. After modernisation it is proposed to increase it to 17 per cent.[1]

Even with deficiences in the canal system and fluctuating irrigation supplies, the performance of Upper Ganga Canal system has been very good over the years because of the established irrigation tradition and standard administrative maintenance procedures. The system started irrigation in 1856 and since then the benefits from irrigation have increased substantially to about 800,000 hectares. Such an old system could have become outmoded but the system has been dynamic ever since its beginning. The main factors to its success can be said to be low intensity of irrigation, good drainage conditions and continuous review of the performance of the canal system and regular rennovation of the ingredients of the system.

Sharda Sahayak System

The old Sarda canal system was commissioned in 1928 to provide protective irrigation to the area lying in Ganga-Ghagra Doab in central U.P. by diverting the water of river Sarda at Banbasa in Nainital district near Himalayan foothills. The area commanded by this system was 24 lakh hectares but due to the shortage of water it was not possible to meet the

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[1] Brief Description of the Progress of Work of Irrigation Department, 1983-84, Investigation and Planning Circle IV, U.P., Lucknow, p.6 (in Hindi).

irrigation requirement of such a large area which is evident from the fact that the average irrigation during 1965-70 was less than 19 per cent of the cultivable area. The Sarda Sahayak Irrigation Project taken up in the late sixties has been designed to provide additional irrigation water in the areas covered by Ganga-Ghagra command east of Lucknow.[1]

Sarda Sahayak Irrigation Project envisages construction of a barrage across river Ghagra at Girjapuri near the Indo-Nepal border, diversion of 480 cusecs of water through 28 kms. link channels into Sarda river, construction of another barrage across Sarda river about 160 kms. downstream of the head works of old Sarda canal system and construction of 260 kms. long feedor channels for augmenting the supply of water for irrigation in the lower reaches of the old Sarda canal system in the area lying between the river Ganga and Ghagra. The project includes remodelling of the entire 6126 kms. long channel and construction of 7273 kms. length of the new channels. With the incorporation of the existing irrigation system of the pump canal schemes of Dohrighat, Dalmau, Tanda and Raunahi in the Sarda Sahayak grid, it is proposed to increase the overall intensity of irrigation in the command area from the originally proposed 85 per cent to 96 per cent of CCA (60 per cent kharif and 36 per cent rabi). It is targetted to provide irrigation facilities in 19.23 lakhs hectares in the 14 districts covering

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[1] Prakash Bahadur, B.N. Asthana and D.K. Gupta : Adverse Effects of Irrigation - Issues, Measures and Approach, IE (I) Journal - C1, Vol.64, July 1983, p.26.

160 blocks in its command including 4.3 lakh hectares benefited by the old Sharda Canal.[1]

According to the Irrigation Department report 1983-84 15.26 lakh hectares of irrigation potential has been created by June 1983. The total estimated cost of the schemes is to the extent of about Rs.600 crores and till March 1983 Rs.376.92 crores had been spent in the various components of the scheme.[2] During 1979-80 1210 thousand hectares of irrigation potential was created and 56 per cent of it was utilised and during 1982-83 1020 thousand hectares of irrigation potential was created and 69 per cent of it was utilised. Upto the same year 701 thousand hectares of irrigation potential was utilised out of ultimate potential of 1923 thousand hectares (being 36.4 per cent). The annual rate of additional utilisation during 1980-83 was 7 thousand hectares, which means that it would need 175 years for the complete utilisation of the balance potential at the existing rate.[3]

Gandak Canal System : Gandak Irrigation Project is a international and inter-state project. The Planning Commission in 1961 approved the Great Gandak Project as a joint venture of U.P. and Bihar States. Two canal systems were introduced from a diversion barrage at Valmiki Nagar near the Indo-Nepal border. Two main canals take off from barrage namely, Western

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[1] B.N. Tyagi : A Study of Change in Agricultural Production Under Command Areas of U.P.; National Seminar on Impact of of Command Area Development Programme on Land and Water Productivity and Economy of the Command Areas, op. cit., p.52.

[2] Brief Description of Work Progress, Irrigation Department, 1983-84, U.P., op. cit., p.8, (in Hindi).

[3] K. Ramanujam; Nine Years of Command Area Development, op. cit., pp.16-17.

Gandak Canal and Tirhut Canal. Tirhut, rising from the eastern side of the barrage serves Bihar and Nepal. West Gandak Canal after flowing 18.93 kms. in Nepal serves Gorakhpur and Deoria districts of U.P. and Saran, Champaran and Muzaffarpur districts of Bihar. The irrigation from the system in the two districts in U.P. started during 1972-73 and it irrigated about 23000 hectares area that year. In U.P. the system has a GCA of 5.35 lakh hectares and a CCA of 4.43 lakh hectares covering 12 blocks of Deoria and 21 blocks of Gorakhpur districts. The head discharge of 15800 cusecs is shared by Bihar and U.P. in which U.P.s share is 7300 cusecs. Due to shortage of water supply in the winter season, as the Great Gandak river is fed from the melting Himalayan snows, the proposed percentage of Rabi irrigation is low. In kharif, there is no paucity of water, as all canals run simultaneously. Hence in kharif 40 per cent CCA, in rabi 20 per cent and in Zaid 15 per cent CCA (mainly sugarcane) is proposed to be irrigated by the system.

The initial cost of the work to be done by U.P. was estimated at Rs.15.47 crore which was later revised to Rs.50.39 crore during the year 1973.[1] However as per the latest report of the U.P. Irrigation Department the estimated cost of the project is Rs.97 crores of which Rs.89.55 crores had been spent by 1982-83.[2] During 1979-80 in U.P. 280 thousand

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[1]Souvenir of National Seminar on Water Management and Salinity Control, March 8-10, 1981, U.P. Government, p.19.

[2]Brief Description of Work Progress, Irrigation Department, 1983-84, U.P., pp.9-10 (in Hindi).

hectares of irrigation potential was created of which 8.6 per cent was utilised and in 1982-83 332 thousand hectares was created and 65 per cent of it was utilised. Upto the same year 217 thousand hectares of irrigation potential was utilised out of ultimate potential 332 thousand hectares (being 65.4 per cent). The annual rate of additional utilisation during 1980-83 was 27 thousand hectares, which means that it would need just 5 years for the complete utilisation of the balance potential at the existing rate.[3]

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[3] K. Ramanujam, Nine Years of Command Area Development, op cit., pp. 16-17.

CHAPTER II

Background of Sample Villages

The sample villages selected by us for the detailed investigation, together with the larger units subsuming them are as under.

Sl. No.	Name of the Village	Block	Tehsil	District	Irrigation System Studied
1.	Misri Dhara	Hata	Hata	Deoria	Gandak (Head-reach)
2.	Kusmauni	Deoria	Deoria	Deoria	Gandak (Tail-end)
3.	Pakri Babu	Bhatpar Rani	Salempur	Deoria	State Tubewell
4.	Piprauli	Banki	Nawab-ganj	Barabanki	Sarda Sahayak (Head-reach)
5.	Fatahabad (Badel)	Banki	Nawab-ganj	Barabanki	Sarda Sahayak (Tail-end)
6.	Darapur	Banki	Nawab-ganj	Barabanki	State Tubewell
7.	Babakpur	Saroor-pur	Sardhana	Meerut	Upper Ganga (Head-reach)
8.	Nagli Isa	Mawana	Mawana	Meerut	Upper Ganga (Tail-end)
9.	Mod Kalan	Hasti-napur	Mawana	Meerut	State Tubewell

1. Misri Dhara : The village is located at a distance of about 3 kms. from Hata Block/Tehsil on the left side of the Hata Kasia national highway. In terms of road transport the village is very well connected but the nearest rail link is at Gauri Bazar at a distance of 16 kms. Deoria, the district head-

quarter is at a distance of 35 kms. The schools (Primary, Junior and High School), college, post office, bank, Primary Health Centre (PHC), police post and agricultural and consumer market centres are in Hata. However, the village does not have electricity. This is particularly surprising since the irrigation department's dak bungalow adjacent to the village has electricity. The villagers get their drinking water from 12 wells and 30 hand pumps in the village.

2. Kusmauni : The village is located at a distance of 13 kms. south-east of Deoria. It is connected with Noon Khar railway station by a semi pucca road covering a distance of 3 kms. However, no public transport plys between Noon Khar and the village. Police post, post office, PHC and schools upto High School are at Baikhunthapur at a distance of 1.5 kms. The village is electrified having 3 flour mills and one oil mill. The drinking water is provided by 7 wells and 25 hand pumps in the village.

3. Pakri Babu : The village is about 36 kms. south-east of Deoria. It is located at a distance of 2.5 kms. from Bhatpar Rani Block on the left side of the Bhatpar Rani Bhimgari metalled road. The PHC, police post, bank, post office, bus station, railway station and market centre for agricultural inputs are at Bhatpar Rani. The extra ordinary thing about the village is that there are seven educational institutions in the village itself, consisting of 2 Primary, 2 Junior, 2 High Schools and 1 Inter College. The village is electrified. The drinking water needs are met by 25 wells and 100 hand pumps.

4. Piprauli : The village lies 11 kms. north-east of Barabanki town and is linked with the Barabanki-Gonda road by one kilometer kachha road. The nearest railway station is Jahangirabad Raj at a distance of 3 kms. and the nearest bus stop is at a distance of 1.5 kms. from the village on Barabanki-Gonda road. The village has a Primary school. The Junior school, High school, bank, police post, post office and PHC are at Masauli at a distance of 6 kms. The Block, Tehsil and district headquarters are located at Barabanki, which also serves as a market centre for consumer goods, crop produce and repair and maintenance of agricultural equipments. The village does not have electricity. There are 45 wells and 30 hand pumps in the village for drinking water purposes.

5. Fatahabad : The village forms a part (Mauza) of the revenue village Badel. It is located south-east of Barabanki. Barabanki Haidergarh road bifurcates the village into two parts. On the right side of the road is the habitation and some of the agricultural land and on the left side is the rest of the land of the villagers. Primary and Junior schools and PHC are in the village itself. For other requirements villagers go to Barabanki which is just 2 kms. from the village and is approachable by all sorts of transport. The village is electrified and there are two flour mills and one oil mill in the village. Drinking water is available through 13 wells and 8 hand pumps.

6. Darapur : The revenue village has two parts, Darapur and Dihuwa. Our investigation is confined to Darapur which is located 5 kms. south-west of Barabanki. The nearest bus stop

is at a distance of 2 kms. from the village at Alapur which is connected to the village by a Kachcha road. There is a primary school in the village but for meeting rest of their requirements they have to go to Barabanki. The village is electrified in the sense that power is provided for the running of tubewells but is not provided for domestic use.

7. Babakpur : It is about 17 kms. north-west of Meerut. Half kilometer bricked road links the village with the Meerut Sardhana metalled road. Tehsil headquarter Sardhana is about 5 kms. from the village. Except a primary school, there is no other facility in the village itself. The nearest police post and Inter College is at Sardhana, Junior School, High School, bus stand, post office, bank, PHC and market centres are at Dabathuwa at a distance of about 2 kms. towards Meerut on Sardhana-Meerut road. Block office Saroorpur is at a distance of about 20 kms. from the village. The village has been provided with electricity for irrigation purposes but not for domestic use. Drinking water requirement is met by 15 wells and 60 hand pumps in the village.

8. Nagli Isa : It is about 14 kms. north-east of Meerut on the left side of Meerut Mawana metalled road. There is a Primary school, a veterinary hospital and the services of a mobile post office in the village but the Junior, High School, Inter College, Degree College, bank, post office and PHC are at Chchota Mawana at a distance of 1.5 kms. from the village. Market centre for agricultural produce, goods, repairs etc. is at Mawana at a distance of 6 kms. which is

also the block and Tehsil headquarter of the village. The village has electricity and there are two flour mills in the village.

9. Mod Kalan : It is about 34 kms. north-east of Meerut. Mawana is about 12 kms. south-west and Hastinapur about 6 kms. north-east of the village. The village is connected with Meerut Bijnor (Muzzaffar Nagar) metalled road covering a distance of 2 kms. The nearest bus stand is at 1.5 kms. distance and a Primary school is in the village itself. The nearest post office is at Mod Khurd at a distance of 1 km. High School, Inter College, market centre, bank and police post are at Beshuma at a distance of 2 kms. The nearest PHC and Degree College is at Hastinapur.

The brief account of the nine sample villages dealing mainly with the locational and amenities factors in the preceding will follow by an examination of the important socio-economic and demographic characteristics and agricultural practices in the sample villages.

Table 2.1 examines the caste structures in sample villages. In Misri Dhara, Yadav, Kori and Kurmi constitute the largest caste group and together with other backwards they are over 65 per cent. But in the economic and political spheres Rajputs with about 14 per cent households dominate the village. They have large land holdings and the village Pradhan is also from their caste group. Brahmins who constitute about 4 per cent possess smaller land holdings in comparison to Rajputs and do

not have much say in the village. In Kusmauni backward castes are dominant numerically, economically and politically. Among them Koiris, who are well known in the area for their vegetable cultivation, have the largest number and possess comparatively larger land holdings, although most of the holdings in the village are small. Telis (another backward caste) do not possess much land but are the richest in the village. Many members of this caste are engaged in service outside the village and they either make remittance to the members of their households living in the village or bring the money with themselves when they come to the village on vacations. The Pradhan also belongs to their caste. Although Bhumihar constitute only 7 per cent of the village household, they maintain a higher social status because of the dominance of this caste in the larger area (Baikunthapur) which subsumes the village. In Pakri Babu, Rajputs are the dominant caste numerically, socially, politically and economically. Their land holdings are much larger compared to those of backwards. Although the village Pradhan is from Lohar caste (backward) he is a rubber stamp in the hands of Rajputs. Among them intra caste rivalry and factional war is noticeable but they get united when confronted with other caste groups. The Rajputs' influence in the area is manifested in the fact that one of their kinsmen is representing the Assembly seat in the State Legislature. In the attainment of education also, the Rajputs are much better placed than other castes in the village. Consequently, apart from agriculture, the members of the caste are engaged in business and service outside the village.

Thus, in two of the three villages in Deoria district backwards are the largest caste group numerically. However, economic, social and political power is in the hands of Rajputs in two villages and only in one village backwards are dominant. Even here Rajputs enjoy a priviledged social status. As regard Brahmins, they are non existent in one village (Pakri Babu) and are insignificant minorities, constituting 4 to 7 per cent in two villages and without any kind of power except a higher social status. Scheduled Castes are in all the villages forming 9 to 17 per cent of households. They are placed at the lowest point of socio-economic and political ladder. Most of them possess such small land holdings that it compells many members of their caste to get engaged as agricultural labourers to supplement their meagre income from subsistence agriculture.

Piprauli has basically a two caste groups structure, where Yadav, Koiri and Kurmi together form about 52 per cent of households while Scheduled Castes constitute about 46 per cent of the households in the village. The dominant caste of the village is Kurmi. Kurmis play an important role in all aspects of the village life. The Pradhan is from their caste. Scheduled Castes, although numerically large, remain subdued. They possess very small land and some of them are engaged as agricultural labours to supplement their income from subsistence farming. Fatahabad again has two caste structure but the proportion unlike Piprauli is in favour of Scheduled Castes. Here, Scheduled Castes constitute about 63 per cent compared to about 35 per cent Kurmi, Koiri and Yadav. In spite of their numerical

strength, the position of Scheduled Castes in this village is no better than their position in Piprauli. Like Piprauli in Fatahabad also, Kurmis are most powerful economically and politically. The Pradhan is also from Kurmi caste. Next to them in power ladder are Yadavs who apart from agriculture do milk business. Dairying is a very profitable proposition for them on account of their expertise in this particular trade and very close proximity of the village (2 kms.) from the district town of Barabanki. Among Scheduled Castes, Chamars have the largest number but their economic position is very depressing. Majority of them possess very little land, compelling them to do share cropping or work as agricultural labour in the village or work as non-agricultural labourers in the town of Barabanki. In Darapur, Yadavs form the dominant caste numerically, economically and politically. They invariably supplement their agricultural income by dairying. The village Pradhan is also their kinsman. Although Brahmins and Rajputs form 5 and 7 per cent household respectively in the village, they have priviledged status on account of their high position in the social hierarchy and also they own large land holdings in the village. Members of their households are also engaged in service. There are about 11 per cent Scheduled Castes in the village but their position is no better than their brethren in the other two villages in the district.

In all three villages in Barabanki district backward castes are dominant numerically, economically and politically. Higher castes like, Brahmins and Rajputs are either non-existent or constitute a very small fragment of the total households in

the villages. Although Scheduled Castes constitute a large proportion of the households in three villages but their economic position on account of very small land holdings is very weak. As a consequence, they do not possess any political power also. Thus, they occupy the lowest place socially, economically and politically in Barabanki.

In Babakpur, Gujjars with about 65 per cent households are the dominant caste followed by about 18 per cent Brahmins, 6 per cent backwards, and 4 per cent muslims. This is the only village in our sample with about only 2 per cent of Scheduled Caste households. An important feature of the villages is that there are no divisions on caste lines and there is complete social harmony. All caste people, including Brahmins, sit, smoke 'hookah' (hubble bubble) and drink together. In Nagli Isa, Scheduled Castes with about 60 per cent households are dominant numerically followed by about 30 per cent Rajputs, 6 per cent Brahmins and 4 per cent backwards. The Scheduled Castes are well off economically. The living standards of the members of this caste is high and their life style, dress, etc. are the same as that of higher castes. Although the Pradhan is from amongst Rajputs but he has to consult the Scheduled Castes in matters involving the village. Rajputs who occupy a higher place in the caste hierarchy are outnumbered by Scheduled Castes numerically. Further, since majority of the Scheduled Castes are well off, Rajputs cannot have any economic leverage over them to dictate terms. As a result, Rajput do not have any kind of control over Scheduled

Castes. This fact is covertly resented by the Rajputs. As a matter of fact, a latent kind of division between them and the Scheduled Castes does exist in the village but it never gets openly manifested and Brahmins work as a balancing factor between them. In Modkalan Jats are the dominant caste and constitute an overwhelming majority of households in the village (71 per cent), followed by Scheduled Castes (19 per cent) and Brahmins (6 per cent). Jats harass and suppress other caste people, particularly the Scheduled Castes. Consequently, some of the Scheduled Caste families have left the village and have taken up works in cities like Meerut and Delhi.

Talking of Meerut district in general, it contains a village where caste differences are conspicuous by their absence and general social harmony is prevalent. The other important thing is that there is one village in the district where Scheduled Castes constitute the dominant caste of the village.

Taking sample villages as a whole, backward castes constitute the largest proportion (41 per cent) of households followed by 25 per cent Scheduled Castes, 15 per cent Gujjars and Jats, 11 per cent Rajputs and 5 per cent Brahmins. Backwards are dominant castes in four villages, three in Barabanki and one in Deoria. Rajputs have control in two villages while Gujjars, Jats and Scheduled Castes are dominant castes in one village each.

Table 2.2 examines the sample villages in terms of some important demographic characteristics. The male-female sex ratio is highest in Nagli Isa with 57.7 per cent males followed by Mod Kalan with 56.7 per cent and Pakri Babu with 56.5 per cent. It is lowest in Babakpur where the percentage of male population is 51.6 per cent compared to 49.4 per cent female population. Taking all the sample villages together, there are 54.4 per cent males compared to 45.6 per cent females.

The average size of the household for all the sample villages is 7.4, the highest being 9.1 for Pakri Babu while the lowest is 5.8 for Piprauli. An important feature in this respect is that there is not much variation in the average size of the households across the villages. By and large, in most of the villages the size varies between 7 and 8. The district-wise pattern in this respect is that Deoria has the largest average size of the household while Barabanki has the smallest.

The participation rate indicates the extent to which members of the population or a section of it take part in economic activity. Generally male participation rate varies less over regions but female participation rate varies widely over regions, villages, etc. on account of caste, economic and local considerations. The participation rate of the male population in the workforce is 51 per cent for all the villages. Babakpur with 69 per cent has the highest male participation rate, followed by Piprauli with 57 per cent, while Nagli Isa with 43 per cent has the lowest participation rate. In rest of the villages across the districts the male participation rate

is more or less uniform varying between 48 and 52 per cent. The main reason of high rate in Babakpur and Piprauli is that Gujjars and Kurmis respectively have large land holdings and they cultivate their land themselves leading to a high male participation rate. In Nagli Isa, where Scheduled Castes have an overwhelming majority, they do not possess much land. However, many male members of Scheduled Caste households have left their families in the village and work outside the village to supplement their family income. This has resulted in the low participation rate among males in Nagli Isa.

The female participation rate in the work force for all the nine villages is 22 per cent. Fatahabad with 38 per cent has the highest female participation rate while Babakpur with 11 per cent has the lowest. An important feature of the female participation is that Barabanki district has a very high female participation rate compared to the other two districts. The reason for this state of affairs is the high proportion of backward and Scheduled Castes in the district (see Table 2.1). It has generally been found that women folk among them, unlike higher castes, do work in the fields. It is perhaps this fact that causes enhanced female participation rate in the district. The overall participation rate for the males and the females put together for the sample villages is 38 per cent. It also shows a district-wise pattern where Barabanki has the highest participation rate, followed by Meerut and Deoria.

The overall rate of literacy for the nine villages is 36 per cent. Pakri Babu with 49.5 per cent has the highest literacy rate. This is quite understandable considering the fact that there are seven educational institutions, ranging from Primary schools to one Inter college in the village itself. Pakri Babu is closely followed by Babakpur with 49.1 per cent literacy rate. Darapur with 23 per cent has the lowest literacy rate. The district-wise pattern emerging from our data suggests that Meerut has the highest proportion of literates while Barabanki has the lowest proportion of literates among the three districts.

The distribution of workers in agriculture and agricultural labour gives an idea about land distribution. More egalitarian distribution implies higher percentage of workers in agriculture and inegalitarian distribution implies higher percentage of workers in agricultural labours. The percentage of workers in "others" (non-agricultural sector) indicates the extent to which the land resources are sufficient for the village community as a whole and/or to what extent other opportunities are available. The distribution of work force (Table 2.3) in nine villages is as follows : 64 per cent is engaged in agriculture, 8 per cent work as agricultural labours and 28 per cent is engaged in non-agricultural sector. The data clearly indicates that a very low proportion of work force is engaged as agricultural labours and a high proportion is occupied with cultivation. The main reason for this kind of distribution is that, we had left out all such households who

were landless and also those who were having less than 0.5 acres of land while drawing our sample. Among the villages, Mod Kalan with 84 per cent has the largest proportion of work force in agriculture, followed by Babakpur with 77 per cent and Piprauli with 69 per cent. Misri Dhara with 49 per cent has the lowest proportion of work force in agriculture. Incidently all the three villages happen to be canal head reach villages where water is expected to be in adequate quantity. The main reason of high proportion of work force in agriculture in the two villages is that the majority of the households in Babakpur and Piprauli are from Jat and Kurmi castes respectively possessing considerable proportion of land in the two villages. Both these castes along with their women folk work in fields. As a result, there is high proportion of work force in agriculture in two villages. In Misri Dhara although backward castes constitute majority of the households in the village, they do not possess adequate land and Rajputs who possess most of the land are not tillers of the land in the strict sense. Their women folk also do not work in the fields by tradition and they prefer engaging agricultural labours for their cultivation.

With respect to agricultural labours, Nagli Isa tops the list with 20 per cent and Darapur with 4 per cent has the lowest proportion of work force engaged as agricultural labours. In Nagli Isa, Scheduled Castes constitute 60 per cent of the households and form the dominant caste of the village. However, more than two-third of the land is owned by Rajputs and Brahmins

and only less than one-third is owned by Scheduled Castes. As mentioned by us in the preceding, the high castes are not tillers of the land in the sense backwards, Gujjars and Jats are and they prefer using agricultural labours for their cultivation. Further, in Nagli Isa the wages of the agricultural labour is quite high and there is no exploitation of the Scheduled Castes. Therefore, most of the Scheduled Castes make good use of the opportunity and work as agricultural labours. In Darapur, on the contrary, there are only 11 per cent of Scheduled Castes and the major land owning castes are backward who do their own cultivation using their family labour. In addition, the town of Barabanki is only 2 kms. from the village to work as "pull" factor for the poor villagers.

In non-agricultural sector, Pakri Babu with 46 per cent households has the highest proportion of work force engaged in this sector and Modkalan with 5 per cent work force in non-agricultural occupations has the lowest proportion in this sector. The high proportion in Pakri Babu is on account of the fact that the level of education in this village is very high and many members of the village, particularly of Rajput caste, are engaged in business or service in nearby towns. The very low proportion of Modkalan is because Jats who own very large land holdings in the village find agriculture a very profitable proposition and they themselves cultivate their land. The Scheduled Castes owning very small land holding work in their own fields and also work as agricultural labours

for the Jats. Thus, on the one hand, there is very high proportion of workers engaged in agriculture and on the other, very negligible proportion of workers go for non-agricultutal works.

The district-wise pattern which emerges from the data indicates that the extent of self-employment in agriculture sector is highest in Meerut, followed by Barabanki and then Deoria. This is because of the high profitability of agriculture in Meerut, followed by Barabanki, then Deoria.

Table 2.4 gives distribution of households by land holding size. But before we discuss the table a few facts about the sample need to be kept in mind. First, we have mentioned this in the preceding also, that there are no landless households in our sample and all the households owned more than 0.5 acres of land. Second, out of the total sample size of 868 only 14 households had a total of 15 acres of unirrigated land out of the net cultivated land totalling 2717 acres. Since almost whole of the land cultivated by the sample households is irrigated, we would term them as follows : less than 1 acre as "marginal", 1.1 to 2.5 acres as "small", 2.6 to 5 acres as "medium" and 5.1 and above as "large".

In Misri Dhara, 86 per cent of households are either "marginal" or "small" with 42 per cent in the former and 44 per cent in the latter. Only 6 per cent households are with "medium" holdings and 8 per cent with "large" holdings. In Misri Dhara, more than one-third of the cultivated land is possessed by 14 per cent Rajputs, and all the "large" land

holdings are owned by them. The average land holding per household is 1.54 acres. In Kusmauni the proportion of "marginal" and "small" households is even higher than Misri Dhara and constitutes 93 per cent of the household with 30 per cent in the "marginal" and 63 per cent in the "small" group. Except Rajputs, who own slightly higher land per household, rest of the castes, including Brahmins, own small land holdings. As a result, there are only 7 per cent households having "medium" holdings and none beyond 5 acres. The average land holding per household is 1.50 acres. Things appear quite different in Pakri Babu where Rajputs constitute majority (44 per cent) of the households. Here 50 per cent of the households are having "small" holdings, followed by 25 per cent "medium", 17 per cent "large" and only 8 per cent "marginal". Majority of the land holdings owned by Rajputs are either large or medium. On the contrary, majority of the backward castes households (45 per cent) own "small" land holdings. The average land holding per household in the village comes to 3.60 acres.

In Pipraull, the largest proportion of the households are "small" with 41 per cent, followed by 28 per cent "marginal", 17 per cent "large" and 15 per cent "medium". Here 52 per cent Backward (Koiri, Kurmi, Yadav) households own 80 per cent of the cultivated land while 46 per cent Scheduled Caste households own 18 per cent of cultivated land. Naturally, the land holdings of the Backward Castes are much bigger than that of Scheduled Castes. The average land holding per household is 2.76 acres.

In Fatahabad 55 per cent of households are "small" followed by 20 per cent "medium", 18 per cent "marginal" and 7 per cent "large". Here 63 per cent of Scheduled Caste households own 28 per cent of land while 35 per cent of Backwards (Koiri, Kurmi, Yadav) own 70 per cent of land. The average land holding per household comes to 2.36 acres. In Darapur 50 per cent of the households are having "small" land holdings, 30 per cent "medium", 10 per cent "marginal" and 8 per cent "large". Here 77 per cent of the households consists of Backward Castes and they own most of the land in the village. They along with a few Brahmin and Rajput households own the larger holdings while the Scheduled Castes own very small land holdings. The average land holding per household is 2.83 acres.

We notice a reversal of the trend in Babakpur. Here 38 per cent households have "medium" holding followed by 27 per cent "small", 26 per cent "large" and only 7 per cent "marginal" holdings. Here 66 per cent Gujjar households own 72 per cent of the cultivated land and 18 per cent Brahmin households own 23 per cent of cultivated land in the village. The average land holding per household is 4.21 acres. In Nagli Isa 42 per cent of the households are having "small" holdings, 29 per cent "large", 21 per cent "medium" and 8 per cent "marginal". Here 6 per cent of Brahmins own 17 per cent of land, 30 per cent of Rajputs own 58 per cent of land and 60 per cent of Scheduled Castes own only 24 per cent of land. The largest holdings per household are owned by Brahmins followed by Rajputs. Scheduled Castes households, on the other hand, have

the smallest holdings. The average land holding per household comes to 3.96 acres. In Modkalan 51 per cent of households have "large" holdings followed by 26 per cent "medium", 17 per cent "marginal" and 6 per cent "small". Here 71 per cent Jats cultivate 96 per cent land while 19 per cent Scheduled Castes and 6 per cent Brahmins own 1 per cent land each. The average land holding per household which comes to 5.72 acres is highest among all the sample villages.

A feature which emerges from the data is that as we move from west (Meerut) to east (Deoria), there is a rapid increase in the proportion of households with marginal and small holdings. The only exception in this respect is Pakri Babu where Rajputs households form a majority. In this respect it is pertinent to note that in all the villages across the three districts, high castes (Brahmins and Rajputs) have generally largest land holdings, whether they constitute majority of the households or a handful of households in the village. Similarly, the Scheduled castes have the smallest holdings in all the villages. The district-wise pattern with respect to caste and the land holding shows that Rajputs are the major land owning caste in Deoria. In Barabanki it is the Kurmis and Yadavs (Backwards) and in Meerut Gujjars and Jats have the largest share in the land. The average landholding per household is largest in Meerut (west), followed by Barabanki (central) and then Deoria (east).

Table 2.5 contains information about leasing activities in sample villages. Here two things need to be mentioned.

First, the average land holding per household does not tally with the figures presented in table 2.4. The reason being in table 2.4 figures relate to average cultivated land holding per household, while in table 2.5 these refer to average land holding owned per household. Second, in the table itself the figures relating to 'leasing in' and 'leasing out' do not tally and generally 'leasing out' is under recorded. It may be on account of two factors. First, those who are 'leasing in' land in a particular village are taking it from persons who have land in that village but they live in a neighbouring village. Since they cannot themselves cultivate that land economically and effectively they lease it out. The second possibility is that those who are leasing out their land are hiding this fact on account of the fear of the stringent land cealing laws.

Leasing in is an operation where owner derives income for "owning" the land, not working on it. Obviously, leasing is less profitable in modern agriculture and is more prevalent in feudal or backward agriculture. However, in some cases leasing in is done to optimize agricultural production. In our sample villages leasing is high in Pakri Babu, Piprauli and Fatahabad and is substantial in Misri Dhara. In Fatahabad, where leasing is highest, the majority of the households (63 per cent) are scheduled castes but most of the land is cultivated by backward castes. Although, the average land owned per household comes to 2.2 acres but most of the scheduled castes own between half to one acre of land. The same is true

of Piprauli except, here scheduled castes constitute the second largest number of households after backward castes. However, it is not scheduled caste households who are leasing in land rather they are backward castes. They are leasing it either from their own kinsmen or it is reverse leasing, where poor lease out the land to the rich. The average area leased in per household is more than one acre.

In Pakri Babu and Misri Dhara the land distribution is skewed in favour of Rajputs who generally possess medium or large holdings. Although, land owned per household in Pakri Babu is 3.5 acres but 50 per cent of the holdings in the village are small. Similarly, in Misri Dhara the average land owned per household is 1.7 acres but 42 per cent of the households have marginal holdings. It is these small and marginal backward castes households in the two villages who lease in land from the Rajputs to make their holdings economically viable for modern farming. In Nagli Isa and Babakpur the proportion of the households leasing in land is not very high but the average area leased in is quite high. It is about 2 acres in Babakpur and about 3 acres in Nagli Isa. In both the villages the average land owned per household is also quite high and is 4.2 acres for Babkpur and 3.7 acres for Nagli Isa. In Babakpur the Gujjars are likely to be leasing in land from their own kinsmen while in Nagli Isa it may be either reverse leasing by Brahmins and Rajputs from scheduled castes or high castes leasing in from their own kinsmen.

With respect to leasing out, we have already mentioned the under-recording of the number of the households as well as the area leased out. The other thing which strikes about leasing out is that the average land leased out per household in Pakri Babu is as high as 2.70 acres while the average area leased in is only 0.9 acres. This means that each Rajput has leased out his land to 3 to 4 backward caste households, most probably on share-cropping basis.

In table 2.6 the same phenomenon of leasing has been examined vis-a-vis land holding size. The first thing that strikes about it is that leasing is maximum in small (1.1 to 2.5 acres) land holding size. This means that land is not leased in by very poor (marginal) farmers whose resource base is very weak. The average land leased per household by this group is 0.9 acres and average land owned by them is 1.5 acres. This means that majority of the households who lease in land are of Backward Castes. This is substantiated by the fact (see table 2.5) that in the villages of Barabanki alone 49 households are engaged in leasing in and in both these villages 70 to 80 per cent of the land is cultivated by Backward castes. As regard the relationship between the size of the land holding and the average area leased in per household, it is to be noted that the relationship is positive. The average area leased in per household for the marginal land holding category is 0.4 acres and it goes upto 2.23 acres for the large land holding category (above 5.1 acres).

Table 2.7 presents some important economic characteristics related to land in sample villages. The average size of the land holding per household for nine sample villages is 3.26 acres but there are significant variations in this respect in different villages. It is largest in Modkalan with 5.72 acres and is smallest in Kusmauni with 1.50 acres. The district-wise pattern as mentioned by us in the preceding indicates that the majority of the holdings in three districts are, large in Meerut, medium in Barabanki and small and marginal in Deoria (except Pakri Babu).

An agricultural holding consists of several plots and all the contiguous plots at one place are treated as the parcel. Agricultural operations become easier economic and efficient if a holding consists of lesser number of larger parcels. Judging from this angle, the average sizes of parcels per household is largest in Meerut, followed by Barabanki and then Deoria.

The most appropriate combination of plough and bullock is one plough and two bullocks per household. However, this combination is prevalent only in two villages of Meerut, i.e., Babakpur and Modkalan. The absence of this combination in Nagli Isa is because the major portion of the cultivated land is in the hands of Rajputs and Brahmins, while the majority of the households (60 per cent) are scheduled castes who are either marginal or small farmers and, therefore, do not have the appropriate combination of plough and bullock. Apart from these two villages, in rest of the villages, by and large every household has one plough and one draught animal. In the

villages where the appropriate combination is missing it may be causing constraint in agricultural operations, on the other hand, this also causes better utilisation of limited resources through exchange/barter or even leasing/hiring.

We have computed the value of improved agricultural implements but not that of traditional agricultural implements. We found that the traditional equipments were more or less uniformly distributed, hence they were left out. The average value of improved agricultural implements per household for all the villages comes out to Rs.3593, varying between Rs.603 and Rs.11999 (a difference of about twenty times). The average value is highest is Modkalan (Rs.11999), followed by Babakpur (Rs.6602), Darapur (Rs.3440), and Nagli Isa (Rs.2825). The average value is lowest in Misri Dhara (Rs.603), preceded by Kusmauni (Rs.1083).

In Modkalan 96 per cent of the land is cultivated by Jats who are hard working tillers of the land. Here, the average landholding per household is also highest (5.72 acres). As a result, Jats invest a lot of money on improved agricultural implements to make agriculture more profitable. The average value falls down by half in case of Babakpur, although it is still quite high with respect to all sample villages. In Babakpur 72 per cent of the land is cultivated by Gujjars and 23 per cent by Brahmins. It has generally been found that Brahmins are not as enterprising and as hard working as Gujjars, Jats, Kurmis, Yadavs and Koiris are. In addition, they themselves are not tillers of the land in the sense the other mentioned castes are. Therefore, it is possible that

the Brahmins do not make investments in improved agricultural implements thereby reducing the overall value in Babakpur in comparison to Modkalan.

The high value in Darapur in comparison to other villages of the district is on account of the presence of a large number of private tubewells and pumping sets in the village. The heavy investment on private irrigation on the part of cultivators is conditioned on account of two factors. First, Darapur is a state tubewell village where the supply of water to farmers is very irregular and inadequate. Second, the dominant caste in the village is Yadav. Yadavs make good income because most of the households are engaged in the profitable dairy business apart from agriculture so they can afford to make investment in the private source of irrigation.

The value in Nagli Isa is less than one-fourth of Modkalan and less than half of Babakpur. The main reason for the low value is 76 per cent of the land is cultivated by 36 per cent Brahmins and Rajputs and another 24 per cent of the land is cultivated by 60 per cent scheduled castes. The scheduled castes would not be investing on improved agricultural implements as they have very small holdings. The Brahmins and Rajput who cultivate large holdings should invest lot of money on improved agricultural implements but by tradition these high castes are neither enterprising nor hard working. They generally do not use their family labour and are contented if they are getting enough crops to live a reasonable life in the village. They are not profit oriented and do not aim self-

progress by maximum efforts. The same is true of the very low value in Misri Dhara where large holdings are possessed by Rajputs.

The reason of low value in Kusmauni is that 93 per cent of holdings are small and marginal. The average land holding and average size of the parcel per household is smallest among the sample villages. As a result, there is not much scope for the investment in improved agricultural implements. Thus, the district-wise pattern which emerges clearly manifests Meerut's pre-eminence in terms of average value of improved agricultural implements followed by Barabanki and then Deoria being at the bottom.

Livestock and poultry is a sector organically related to agriculture as it supplies, animal power and manure to agriculture and agriculture supplies feed (a by-product) to livestock and poultry. There is a positive relationship between prosperous agriculture and extensive livestock, though prosperous agriculture, no doubt, is a function of high investment in improved agricultural implements. The table also confirms this pattern village-wise except in case of Misri Dhara and Nagli Isa, where average value of livestock and poultry per household is higher in proportion to average value of improved agricultural implements per household. In both these villages major portion of the cultivated land is in the hands of high caste and this is in line with the general pattern of living of high castes who like to have greater number of livestocks, particularly milch animals. As regard the district pattern, the livestock and poultry values show

it much more precisely than the value of improved agricultural implement : Meerut tops the list followed by Barabanki and then Deoria.

Details of improved agricultural implements vis-a-vis land holding categories have been presented in table 2.8. The first thing which strikes in the table is that there is one household each with a tractor, with a tubewell and with a pumpset in the land holding category of less than one acre. Obviously it does not appear to be realistic. The reason for this may be that some of the households in the sample villages had part of their cultivated land in the adjoining villages. But in the survey we confined ourselves to the land cultivated in the sample villages alone and did not include the land outside it. It is this fact which seems to have caused this distortion.

Even a casual glance over the table makes it clear that there is a positive relationship between the land holding categories and owning of improved agricultural implements. Among the different improved agricultural implements the ownership of the least costly implement begins at a smaller land holding level. For instance, the ownership of chara cutter begins at the level of marginal holding while that of thrasher, pumpset and tubewell at the level of small holding. And as the land holding categories increase the proportion of the ownership of these implements also goes on increasing. The ownership of tractor actually begins at the level of medium holding and at the level of 5.1 to 10 acres category about 7

per cent of the households own it but in the land holding category of 10 acres and above, 29 per cent households own it. The positive relationship is most clearly manifested between the size of the landholding and the average value of improved agricultural implements per household. This value is Rs.591 for the land holding category of less than 1 acre and the value goes on increasing with the increase in the land holding size, so much so that the value reaches Rs.18402 for the land holding category of above 10 acres.

Some important information on borrowing in sample villages has been examined in table 2.9. A farmer takes loan either for improving his income/assets or to meet his domestic and social requirements. The loans from institutional agencies is given only for the first purpose and has been taken mainly for buying improved agricultural implements or inputs, while the loan from money lenders and other sources is obtained for increase in income/assets or to meet the domestic and social needs by a farmer. We would like to examine the source of the loan and the extent of the loan in the sample villages.

If we examine the proportion of households borrowing from the institutional agencies in relation to the total households in sample villages, we find the highest proportion of borrowing households from this source are in Misri Dhara followed by Babakpur, Piprauli, Modkalan and Nagli Isa in that order. This means that three canal head-reach villages from three districts in particular and Meerut district in

general rank high in this respect. This is so because in all the head-reach villages, there is relative abundance of irrigation water so farmers like to take loans for inputs and improved agricultural implements. In case of Meerut, we have found that the district has advanced agriculture in comparison to other two districts as a result, greater proportion of households go for loans from institutional agencies. In case of money lender, the first three villages, in terms of high proportion of households taking loans from this source, are from district Deoria. Money lender as a lending source is in vogue in backward areas where institutional loaning facilities do not exist, or in villages where farmers have such small land holdings that bank does not accept it as a security/guarantee against the loan, or the loan is taken to meet the domestic or social needs (death, marriage, etc.). One or more than one of these conditions prevail in each of Deoria villages.

Let us now examine how the villages stand in respect to average amount outstanding per borrowing household. With respect to institutional agencies, it is highest (Rs.6940) for Pakri Babu followed by Modkalan (Rs.3890), Darapur (Rs. 3660) and Babakpur (Rs.3530). Pakri Babu is a village where big land owning educated Rajputs are in majority. Many of them are in service in the Block, Tehsil and District. With their connections, education and security of land they have been able to obtain lot of loans from institutional agencies. In case of Darapur, the overwhelming majority is that of backward castes who possess medium holdings. In Darapur public

irrigation is through a state tubewell whose water supply is grossly inadequate and irregular. Therefore, a large number of households are having private tubewells and pumping sets (33.7 per cent) and a lot of them (33.3 per cent) have obtained loan from one or the other institutional source. Close proximity to Barabanki (5 kms.) which has Block, Tehsil and District headquarters has facilitated access to several institutional loaning sources. In case of Modkalan and Babakpur, Jats and Gujjars respectively constitute dominant castes of the two villages. They are enterprising and have profitable agriculture for which they do not hesitate in taking loans and they have big landholdings to provide a guarantee against the loan. One difference among the villages is that while in both Pakri Babu and Darapur the loan is taken by about 25 per cent of the households, in case of Babakpur and Modkalan it is taken by about 65 per cent and 54 per cent respectively. This means that inequalities are least dispersed in Pakri Babu and are most dispersed in Babakpur.

Average outstanding amount per borrowing household from money lender is high in Meerut and Deoria. In Meerut, although the average amount is high but a few households have made use of the source. In Deoria on the contrary, not only average amount per borrowing household is high but a high proportion of households have made use of this source. It is on account of one or more than one of the three reasons mentioned by us in the preceding which induce farmers to take loan from the money lender. Overall borrowing per household (as distinct from per borrowing household) shows almost the same trend which

is discernable in case of institutional borrowing. It is maximum in Pakri Babu (Rs.2720) followed by Babakpur (Rs.2570), and then Modkalan (Rs.2520).

Table 2.10 contains some important economic characteristics related to cultivation in sample villages. In terms of net cropped area Modkalan with 515 acres comes first, followed by Babakpur with 441.8 acres and Nagli Isa with 355.9 acres (all Meerut). Kusmauni with 150.1 acres net cropped area is at the bottom preceded by Misri Dhara with 166.5 acres. However in terms of cropping intensity Misri Dhara with 201 per cent cropping intensity tops the list, followed by Fatahabad with 194.6 per cent, Kusmauni with 172.3 per cent and Pakri Babu with 170.8 per cent. The district-wise pattern which emerges is that, cropping intensity is low in Meerut, medium in Barabanki, with the exception of Fatahabad, and high in Deoria. The low cropping intensity in all the villages of Meerut is on account of extensive cultivation of sugarcane which was treated as one crop by our data collection team.

Examining the data in terms of gross irrigated area as proportion of gross cropped area, we find the first three positions are held by Babakpur (98.2 per cent), Misri Dhara (96.9 per cent) and Piprauli (95.9 per cent). The next three positions are held by Fatahabad (91.5 per cent), Kusmauni (86.2 per cent) and Nagli Isa (85.3 per cent). The last three positions in terms of ranking are held by Modkalan (82.6 per cent), Pakri Babu (77.7 per cent) and Darapur (69.1 per cent). Incidently the first three and the second three villages are canal head-reach and canal tail-end villages

respectively from the three districts while the last three villages are the ones with state tubewells. This means that canal as a source of irrigation is much more dependable than state tubewell.

In all the villages 42.4 per cent of the gross cropped area consists of Kharif crop, 50.9 per cent of Rabi crop and 6.7 per cent of Zaid (summer) crop. In the three villages of Deoria about 48 to 52 per cent of area is Kharif as well as Rabi cropped. In Barabanki and Deoria districts half of the area is in Kharif and the other half is in Rabi and in both the districts Zaid cropped area is negligible. In Meerut villages, Kharif cropped area varies from about 31 to 38 per cent while Rabi cropped area consists of 49 to 60 per cent of gross cropped area. Low acreage under Kharif is on account that sugarcane has been counted as Rabi crop in greater number of cases. Unlike the other two districts, in Meerut noticeable acreage is under Zaid. So much so, that in one of the villages (Modkalan), Zaid cropped area forms a significant Chunk consisting of 21.6 per cent of gross cropped area. Meerut farmers grow fodder in larger area during summer.

The important crops and cropping pattern in the nine villages is presented in Table 2.11. In 7 villages wheat is the most important crop in the sense that it occupies largest proportion of the gross cropped area in each village. Misri Dhara with 43.6 per cent of the gross cropped area under wheat tops the list followed by Kusmauni (41.3 per cent), Nagli Isa (39 per cent), Piprauli (37.4 per cent), Darapur (33.1 per cent) Fatahabad and Fakri Babu (both 32.5 per cent). In two villages

sugarcane is the most important crop. It covers 40 per cent area in Babakpur and 38.5 per cent area in Modkalan. In six villages of Deoria and Barabanki paddy is the second most important crop with Kusmauni having the largest proportion (40.8 per cent) of area under this crop followed by Misri Dhara (40.2 per cent), Piprauli (35.6 per cent), Fatahabad (30.2 per cent), Pakri Babu (27.8 per cent) and Darapur (22.5 per cent). In Babakpur and Modkalan wheat is the second most important crop occupying 34.6 per cent and 31.4 per cent of the area respectively. In Nagli Isa sugarcane is the second most important crop covering 29.7 per cent of area. The third important crop in 4 villages, 2 each from Deoria and Barabanki, is sugarcane. Maize is the third important crop in Pakri Babu, while potato in Fatahabad, Pulses in Babakpur and Fodder in Nagli Isa and Modkalan are the third most important crops. The other important crops for Deoria are pulses (Misri Dhara and Kusmauni), gram and millet (Pakri Babu). In case of Barabanki, potato, poppy and pulses in order of importance are the other important crops. Paddy is the most insignificant crop for all the villages of Meerut.

CHAPTER III

Irrigation Systems

The selection of villages from each district was done on the consideration of dominant mode of irrigation system prevailing there. However, none of them was a pure category for all the households in a village. Therefore, we have taken the households on the basis of main source of irrigation used by them. The main source may be a single irrigation system or a combination of two. Table 3.1 distributes households on that account. Since we have taken four types of irrigation system, theoretically there can be ten types, four pure and six combinations of twos. In reality, we have evolved eight types of systems plus one more category of "others" which consists of combinations of more than two and households with unirrigated areas. The two combinations which are left out are CNL + STW and STW + TRD. The latter was left out because there was no household in that category. In case of former, although two households were there but it was thought that the number was too small to deserve a separate category, hence it was merged with the others category. As a matter of fact, there is a guideline on the part of government that no state tubewell would be provided in the command of a canal irrigation system. One of the villages in our sample in Meerut district, however, contained the land commanded by state tubewell as well

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Note : This chapter onwards following abbreviations have been used for the irrigation systems described by us : CNL = canal, STW = state tubewell, PTW = private tubewell (includes pumpset) and TRD = traditional.

as by canal. Although both the systems have separate commands but two households had some land under canal and some under tubewell command. Generally we do not expect households with STW irrigated area in a CNL area and vice versa but there are 3 households in Darapur (a STW village) using canal water and 1 household in Babakpur (CNL village) using STW irrigation in our sample.

If we examine the table 3.1, we find that 85 per cent of households in Misri Dhara are using canal water for irrigation and the other 15 per cent are using canal water in combination with some traditional source or are using traditional source alone. Misri Dhara being a canal head-reach village of Gandak system, we expect a relative abundance of canal water here which is substantiated by the table. Kusmauni is a tail-end village of the same system where largest proportion of households (30 per cent) are supplementing canal water with PTW followed by those who are supplementing canal water with traditional sources of irrigation (23 per cent). Those who are using mainly canal water are 18 per cent and those who are using mainly PTW are 8 per cent. There are two important differences here in comparison to Misri Dhara. First, there are very few households who are using mainly canal water. Second, quite a few households are depending exclusively on PTW. Pakri Babu is a village with a state tubewell. Here, the largest proportion of households (32 per cent) are supplementing STW irrigation with PTW followed by those who are using a combination of PTW and TRD (28 per cent). At the third

place are those who are using PTW irrigation (27 per cent). There are mere 2 per cent households using STW irrigation which itself speaks of the poor performance of this system of public irrigation. In Pakri Babu, PTW emerges as the most dominant source of irrigation. Most of the households are using it alone or in combination with some other source.

Piprauli is a head-reach village under Sharda Sahayak system. Here 60 per cent of households are using canal irrigation and another 34 per cent are supplementing canal water either with PTW or with TRD. In Fatahabad, which is a tail-end village under the same irrigation system, farmers are using all kinds of irrigation systems singly or in combination with some other system. However, canal irrigation in combination with PTW (25 per cent) or TRD (21 per cent) is the major source of irrigation. Although Darapur is a village commanded by a state tubewell the largest proportion of households (41 per cent) is using PTW. Next in line are those using a combination of STW and PTW (36 per cent) followed by 15 per cent of the households using STW irrigation.

Babakpur is a head-reach village under Upper Ganga system. The majority of households in the village (51 per cent) are using a combination of CNL and PTW and another 44 per cent are using canal irrigation. In Nagli Isa, the tail-end village under the same system, the largest proportion (41 per cent) is using again the same combination of CNL and PTW followed by those using PTW (31 per cent) and then CNL (19 per cent). Although Modkalan was selected by us as a state tubewell village , the land of the village is commanded by two state

tubewells and the tail-end of Bahsuma minor (Upper Ganga Canal System). Here the largest proportion of the households are using PTW in combination either with STW or with CNL (37 per cent), followed by those who are using a combination of more than two irrigation systems (32 per cent) and then there are 18 per cent households using mainly PTW.

If we look at the table across the villages, we find that canal is the most predominant source of irrigation in all the canal head-reach villages and is the most important source of irrigation in combination with PTW in all the canal tail-end villages. PTW is most important in all the state tubewell villages rather than STW itself. This itself speaks of the very poor performance of the state tubewells. Over all, 28 per cent of total sample households use mainly canal water and another 29 per cent use it in combination with PTW and TRD. This means that canal as a source is used by 57 per cent of the households. In comparison STW, the other public irrigation system, is used by only 3 per cent of the household. Another 9 per cent households use it in combination with PTW, which means an overall use by 12 per cent of the households. However, if we leave the households of 3 STW villages and take only those households whose lands are commanded by canal systems, we find that canal water is used alone or as a supplement by 74 per cent of the households it is supposed to cover (Modkalan included) while only 39 per cent of the households commanded by the state tubewell make some use of STW irrigation. Therefore, between the two public

irrigation systems, canal fares much better than tubewell. In terms of importance, canal is the most important system followed by PTW. STW is slightly better used system than TRD but far below in importance to canal and PTW.

In table 3.2 again the villages are classified according to irrigation systems but the criteria is percentage of area irrigated by different sources in each village. Here we have taken only the single systems and not the combination. In case of combinations the dominant source has been treated as the irrigation system. In Misri Dhara 87 per cent of area is irrigated by canal which speaks of the importance of canal in the village. In Kusmauni again canal is the most important source irrigating 47 per cent of area. Nevertheless PTW and TRD are also quite important in the village irrigating 34 per cent and 19 per cent of the area respectively. In Pakri Babu PTW appears to be the lone source irrigating 94 per cent of area.

In Piprauli, canal again is the most important source irrigating 88 per cent of gross irrigated area. In Fatahabad PTW is the most important source irrigating 40 per cent of area followed by TRD with 34 per cent and canal with 26 per cent. In Darapur also PTW is the most important source irrigating 78 per cent of area followed by STW with 22 per cent of area.

In Babakpur and Nagli Isa canal once again is the most important source irrigating 86 per cent and 60 per cent of area respectively. In Nagli Isa rest of the 40 per cent of area is

irrigated by PTW. In Modkalan PTW is most important source irrigating 71 per cent of area, followed by CNL irrigating 17 per cent and STW irrigating 12 per cent of the area.

Thus, canal is the most important source of irrigation in Misri Dhara, Babakpur, Piprauli, Nagli Isa and Kusmauni. In the first three villages it irrigates around 88 per cent of area while in the fourth and fifth 60 per cent and 47 per cent respectively is irrigated by canal. First three villages are canal head-reach villages while the last two are canal tail-end villages. In all canal villages, except Fatahabad, canal is the most important source of irrigation, although a much greater proportion of gross irrigated area finds place in canal head-reach villages compared to canal tail-end villages. In case of STW, the other public irrigation system, it is not at all important source in any of the villages. Of the three STW villages; in case of Pakri Babu it irrigates only 0.3 per cent area, in Modkalan it irrigates 12 per cent area and in Darapur it irrigates 21 per cent area. PTW is the most important source in all the STW villages irrigating 94 per cent area in Pakri Babu, 78 per cent in Darapur and 71 per cent in Modkalan. In addition, in Fatahabad also it is the most important source of irrigating 40 per cent of area. In two villages, Nagli Isa and Kusmauni, it is the second most important source of irrigation after canal. TRD is also not very important source of irrigation in any of the villages. However, in two of the villages, namely Fatahabad and Kusmauni it irrigates substantial area, i.e. 35 per cent in Fatahahad and 19 per cent in Kusmauni. Overall, 47 per cent of the gross

irrigated area in all the villages comes under canal, closely followed by 43 per cent under PTW. STW irrigates 4 per cent of area while TRD provides irrigation to 6 per cent area in all the villages.

Table 3.3 presents distribution of households by land-holding categories in different irrigation systems. In the category of marginal, 52 per cent of the households are using canal water and another 18 per cent are supplementing CNL either with PTW or TRD. For small farmers also canal is the most important source as 27 per cent of the households are irrigating by CNL and another 19 per cent are using a combination of CNL and PTW followed by 18 per cent of households using PTW irrigation. In case of medium households, the combination of CNL and PTW is the most important one as 27 per cent of the households are using this combination for irrigation followed by 19 per cent using canal and 13 per cent each using PTW alone and PTW in combination with STW. In the category of large, the combination of CNL and PTW is again the most important one used by 38 per cent of the households followed by CNL used by 17 per cent of the households and 12 per cent each using PTW and the combination of PTW and STW. In this category a very high proportion of households find a place under "Others" which includes all those households who are having unirrigated land, using the combination of CNL and STW and a combination of more than two systems. Therefore, for analytical purposes "others" is not important. An important feature which emerges from the table is that of the two private irrigation systems, traditional

is used by largest proportion of marginal households while PTW is more in vogue among the households belonging to small or the higher land holding categories.

Table 3.4 examines the details of improved agricultural implements vis-a-vis various irrigation systems. If we compare the average value of the total improved agricultural implements, we find it is highest with Rs.7630 per household in the category of "others" containing a total of 79 households. This is a very high value considering the fact that it contains 33 marginal and small households (including the 13 unirrigated households). The main reason of high value under this category is that there are 26 households in Modkalan who are using a combination of STW, CNL and PTW and majority of them are owning very large land holdings. As a matter of fact, the landholdings of 9 of them are above 10 acres. It is these big landowners who use all kinds of improved agricultural implements, thereby enhancing the average value in that category.

As regard our analytical categories, the highest average value of improved agricultural implements per household is Rs.4962 among the households using the combination of CNL and PTW, followed by Rs.4497 under PTW, and then Rs.3867 under STW and PTW. The lowest value is to be found in case of the households using TRD (Rs.105), preceded by PTW + TRD (Rs.199) and by CNL + TRD (Rs.217). It is clear from the table that the least resourceful households are those who are using TRD alone or in combination with other sources. The other fact that emerges from the table is that none of the 40 odd households

who are using PTW + TRD own either a pumpset or a tubewell and all of them are hiring these to supplement their irrigation through TRD sources. The most resourceful in terms of improved agricultural implements are those who are using PTW or PTW + CNL. To own a tubewell is a function of resource and owning a tubewell reduces the risk element in agriculture, particularly, in areas where canal water is also available. This means owning more improved agricultural implements for a profitable agriculture. Therefore, it is quite logical that the farmers under these two categories are most resourceful.

Table 3.5 presents the land use pattern for nine irrigation systems. It first tells the total area irrigated by a single system and then it also tells about the proportion of the sources in case where area is irrigated by a combination. In case of single systems, the largest area to the tune of 882 acres is irrigated by canal followed by 422 acres by PTW and comparatively very little area to the tune of 90 acres and 43 acres is irrigated by STW and TRD respectively. The combination of CNL + PTW irrigates 1161 acres in which the contribution of CNL is 57 per cent while that of PTW 43 per cent. The combination of more than two systems irrigates 460 acres of area, in which the contribution of PTW is 55 per cent being the highest. The rest 45 per cent is divided among CNL (19 per cent), STW (14 per cent) and TRD (12 per cent). The combination of STW + PTW irrigates 409 acres in which the contribution of PTW is 90 per cent while that of STW is 10 per cent. The combination of CNL + TRD irrigates 189 acres containing the contribution CNL 53

per cent and that of TRD 47 per cent. The smallest area, i.e. 135 acres, is irrigated by PTW + TRD in which the contribution of PTW is 70 per cent.

Some important economic characteristics related to cultivation in different irrigation systems have been presented in table 3.6. An examination of the net cropped area per household shows that the largest cropped area per household comes under the category of "others" which generally contains a combination of more than two irrigation sources. The very high cropped area under this category is on account of the fact 15 households in this category possess large landholdings (5 to 10 acres) and 11 household are owning more than 10 acres of land. It is these households under this category who are enhancing the net cropped area per household to the extent of 5.3 acres. The next highest figure is 4.4 acres (CNL + PTW), followed by 4.3 (STW + PTW) acres and then 3 acres (PTW). The high figures under these categories are understandable because a very large proportion of households under these systems owns a tubewell/pumpset and one makes an investment on a tubewell/pumpset mainly because he owns enough land to make the investment economically viable. The proportion of those owning a PTW/PS is as high as 35 per cent in case of PTW, 34 per cent in case of PTW + STW and 26 per cent in case of CNL + PTW (see table 3.4). A lower proportion in case of PTW + STW is on account of lesser assurance of water supply by STW. The lowest cropped area per household is owned by those who are either using TRD exclusively or TRD in combination with CNL. Generally TRD as a source of irrigation is

used by very small farmers and is substantiated by the fact that 79 per cent households under TRD and 78 per cent households under TRD + CNL are cultivating less than 2.5 acres of land.

In terms of cropping intensity CNL households with 201 per cent rank first followed by CNL + TRD with 187 per cent and then TRD with 178 per cent. The main reason of high intensity under these systems is that over three-fourth of the households belonging to these system constitute "marginal" and "small" farmers owning small landholding which is borne out by the fact that the net cropped area per household under these systems, particularly under TRD and under CNL + TRD is very low. In terms of cropping intensity the bottom place is acquired by the households belonging to "others" category with an intensity of 144 per cent preceded by those belonging to CNL + PTW with cropping intensity of 149 per cent. In case of former 34 per cent of households are "large" land holders and the net cropped area per household is 5.3 acre, while in the case of latter 31 per cent are large land holders and the net cropped area per household is 4.4 acres. Actually the smaller the farmer the more intensive use of his limited land resources he makes and the larger the farmer the less intensive use of his land he makes. This phenomenon has empirically been varified in several studies.[1]

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[1]Small Farmers and Landless in South Asia : World Bank Staff Working Paper No.320, February 1979, p.41.

Almost the same pattern is discernable if we examine the gross irrigated area as per cent of gross cropped area in different irrigation systems. Here it is highest among STW households with 99 per cent. This brings the question then why STW has low cropping intensity. The main reason of low cropping intensity in STW is that a large part of area under this system is sugar cropped (in Modkalan) which has been treated as a single crop by us. As a result, the intensity remains low but the gross irrigated area becomes high. The second and the third place in terms of gross irrigated area as per cent of gross cropped area is obtained by CNL with 97 per cent and CNL + TRD with 93 per cent. The bottom place goes to "others" with 75 per cent preceded by STW + PTW with 77 per cent.

One aspect which is very much relevant to a common property resource is how the gains of common property are shared or distributed among the participants. This is true of a community or public irrigation system. Therefore, we have addressed ourselves to the question how water is distributed in public irrigation systems, i.e. canal and state tubewell, and in the event of a conflict concerning distribution what mechanism is adopted for the resolution of conflicts. Table 3.7 examines the mode of sharing canal water in head-reach and tail-end villages under three canal irrigation systems. One thing which comes out clearly from the table is that "osrabandi" or "warabandi" is very much in vogue in Upper Ganga and Sharda Sahayak systems. Osrabandi is made of Osra + bandi. Osra refers to a portion of land

which may be a chak of a farmer, a thok of a group of farmers and may also be whole village land while bandi refers to fixation. Similarly warabandi is made of wara + bandi. Wara refers to turn and bandi means fixation. Although both refer to the same phenomenon, i.e. mode of distribution of shares of water of the outlet among the beneficiary farmers, warabandi is done for individual farmers. Osrabandi, on the other hand, may be done for one farmer (chak-wise), a group of farmers (Thok-wise) and for all villagers (village-wise). In both the systems each claimant (a farmer or groups of them) is allocated a specific time duration on a particular day based on the total time for which warabandi/osrabandi is done. Generally the time duration for which warabandi or osrabandi is done is one week and the share is basically decided in terms of time interval as a fraction of the total hours in a week for which an individual cultivator or a group of cultivators or a village is entitled to use the available water for irrigation.[1]

Historically speaking the need of osrabandi was first felt on Upper Ganga Canal system when due to increase in the use of canal water for irrigation, quarrels were started among the cultivators and generally the weaker ones were not allowed for use of water. The Northern Canal and Drainage Act, 1873 conferred rights of distribution of water with the beneficiaries who are supposed to fix and apportion their shares by mutual

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[1]Osrabandi System in Uttar Pradesh, Irrigation Department, U.P., 1980, p.1.

agreements. Only in cases of disputes the beneficiaries were required to apply to the Executive Engineer for an Osrabandi under the above Act. Three types of osrabandi, namely chak-wise (for individual farmers), thok-wise (for a group farmers) and village-wise (for all villagers) can be prepared according to the convenience of the cultivators.[1] In the older systems of irrigation in U.P. osrabandi is widely prevalent. Efforts are now being made to adopt it in new canal systems, particularly in the large ones.

One thing which strikes most in the table (3.7) is that osrabandi is in vogue to a much greater extent in head-reach villages compared to tail-end villages in the two irrigation systems (Upper Ganga and Sharda Sahayak) where it operates. Further, in the tail-end villages itself it is much more in vogue in Upper Ganga than Sharda Sahayak. In Upper Ganga 100 per cent head-reach respondents adopted it compared to 80 per cent tail-end respondents who used it as a mode of sharing canal water. In Sharda Sahayak while 95 per cent farmers adopted it in head-reach village only 33 per cent adopted in tail-end village. It is very clear from the table that "Osrabandi" is very much successful in Upper Ganga, to some extent successful in Sharda Sahayak and was not used at all in Gandak system. The reason for this state of affairs is that Upper Ganga is a very old system and "Osrabandi" in this system was started after the canal started operating. The system has got stabilised and institutionalised over the

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[1] Ibid., p.3.

sugarcane is the most important crop. It covers 40 per cent area in Babakpur and 38.5 per cent area in Modkalan. In six villages of Deoria and Barabanki paddy is the second most important crop with Kusmauni having the largest proportion (40.8 per cent) of area under this crop followed by Misri Dhara (40.2 per cent), Piprauli (35.6 per cent), Fatahabad (30.2 per cent), Pakri Babu (27.8 per cent) and Darapur (22.5 per cent). In Babakpur and Modkalan wheat is the second most important crop occupying 34.6 per cent and 31.4 per cent of the area respectively. In Nagli Isa sugarcane is the second most important crop covering 29.7 per cent of area. The third important crop in 4 villages, 2 each from Deoria and Barabanki, is sugarcane. Maize is the third important crop in Pakri Babu, while potato in Fatahabad, Pulses in Babakpur and Fodder in Nagli Isa and Modkalan are the third most important crops. The other important crops for Deoria are pulses (Misri Dhara and Kusmauni), gram and millet (Pakri Babu). In case of Barabanki, potato, poppy and pulses in order of importance are the other important crops. Paddy is the most insignificant crop for all the villages of Meerut.

last one century. In case of Sharda Sahayak, the system is not that old but is old enough to give credence to "Osrabandi" system. In case of Gandak, the system is very new. It started operating in 1972 and the government has been trying to start "Warabandi" here as per the national programme. In addition, Gandak system covers the states of Bihar and U.P. Bihar has not completed its system as yet and allows lot of water to go to U.P. So there is lot of surplus water and farmers do not feel any kind of inadequacy. Therefore, "Osrabandi" as a mode of distribution of water does not find place in Gandak system.

Another mode of distribution of water is, mutual understanding. According to this, generally one who starts irrigating his field first is allowed to complete his irrigation. 58 per cent farmers in Misri Dhara and 39 per cent in Kusmauni (both in Gandak) resort to this method. Another mode which is quite commonly used is that of "might is right". 33 per cent of respondents mentioned that it was in vogue in Misri Dhara, the same was repeated by 36 per cent respondents in Kusmauni, 42 per cent in Fatahabad and 16 per cent in Nagli Isa. One more mode of distribution of water is, irrigating upward to downward. This mode is mentioned by 22 per cent respondents in Kusmauni, 18 per cent in Fatahabad and 8 per cent in Misri Dhara.

The same phenomenon, i.e. mode of sharing STW water has been examined by us in Table 3.8. The most often mentioned mode (except Modkalan where it comes second) is; "might is

right". It is prevalent because of the very irregular and uncertain electric supply. Therefore, as soon as electricity comes every one wants to take water but in this scramble only the mighty succeed. The prevalence of this mode was mentioned by 96 per cent respondents of Darapur, 64 per cent of Pakri Babu and 23 per cent of Modkalan. Osrabandi/Warabandi is mentioned by 70 per cent of Modkalan (Meerut) respondents but none in other two villages. The other mode of distribution of STW water among the beneficiary farmers is that of mutual understanding which means, generally one who starts irrigating his field first is allowed to complete the irrigation. It was mentioned by 18 per cent of respondents in Pakri Babu and 4 per cent in Modkalan. Taking a totalistic view of the table two things clearly emerge. First, in all villages uncertain and irregular supply of electricity has led to a situation where anarchy is the order of the day. Second, despite the fact that 23 per cent respondents in Modkalan make a mention of uncertain electricity and anarchy, one-third of them do mention about the adoption of Osrabandi. Therefore, studying this table along with 3.7, we find that osrabandi is very much in vogue in the western district of Meerut and to some extent in the central district of Barabanki but does not at all exist in the eastern district of Deoria. The second point is that osrabandi is much more wide spread phenomenon in canal than STW. In Meerut it does exist but is non-existent in Barabanki. The main culprit appears to be uncertain electric supply.

One aspect which is closely related to the distribution of water is the mechanism of conflict resolution. There are bound to be conflicts over the distribution of the water except where the distribution procedure is fool proof and is strictly adhered to by the farmers as in the case of good Osrabandi. In our survey, we asked all the respondents who are using a public irrigation system the following question : "In case of conflicts among farmers, how are they resolved"? This question immediately followed the question pertaining to mode of sharing water through public irrigation systems. The responses to the question concerning canal water have been presented in Table 3.9. First thing we notice in the table is that large proportion of farmers, particularly in the head-reach villages, mention that generally there are no conflicts. In Babakpur 74 per cent, in Piprauli 53 per cent and in Misri Dhara 37 per cent so mention. This gives a comparative idea of the success of Osrabandi in Babakpur and Piprauli. It seems Osrabandi is more fool proof in Babakpur compared to Piprauli. The high proportion of such farmers in Misri Dhara is on account of the fact that there is no shortage of water except on high lands. It is this reason which eliminates chances of conflict considerably. The most common mode of conflict solution is "mutual reconciliation with or without the third party". It was mentioned by 30 per cent farmers in Misri Dhara, 13 per cent in Piprauli, where it is second most important mode, and 21 per cent in Babakpur. "Might is right" is the most important mode of conflict resolution in Piprauli where it was mentioned by 23 per cent of respondents. In Misri Dhara it was mentioned by 13

per cent of respondents and in Babakpur by only 4 per cent. Village Pradhan's help was sought quite often (21 per cent) in Misri Dhara and sometimes (11 per cent) in Piprauli but never in Babakpur.

In all tail-end villages "mutual reconciliation with or without third party" was the most important mode. It was mentioned by 48 per cent farmers in Nagli Isa, 33 per cent farmers in Kusmauni and 25 per cent farmers in Fatahabad. "Might is right" is the second most important mode and was mentioned by 30 per cent in Kusmauni, 22 per cent in Nagli Isa and 15 per cent in Fatahabad. Seeking the help of village Pradhan was third important mode mentioned by 23 per cent in Kusmauni, and 10 per cent in Fatahabad but by none in Nagli Isa. On the basis of the table the district-wise pattern which emerges is that mutual reconciliation with or without third party is most common in Meerut and Deoria. Help of village Pradhan is most commonly taken in Deoria and sometimes in Barabanki but he is never approached in Meerut. In Barabanki, in the head-reach village (Piprauli) "might is right" is the order of the day, while in the tail-end village (Fatahabad) "mutual reconciliation with or without the third party" is used more often.

The same phenomenon of resolution of conflicts in the context of STW irrigation has been examined in table 3.10. "Mutual reconciliation with or without third party" has again been the most common mode of conflict resolution in the overall sample and is the most important mode in Modkalan, as 57 per

cent of respondents make a mention of it. However, each village is marked by its own peculiarity with respect to conflict resolution. "Might is right" is most common in Pakri Babu, as 62 per cent of respondents make a mention of it. In Darapur, 58 per cent of respondents mention that generally there are no conflicts. In Pakri Babu and Darapur sometimes the help of Thokdar/Pradhan/operator is taken in resolving the conflicts but they are never pressed into service in Meerut. If we examine this table along with table 3.9, we find that in Deoria the Village Pradhan is pressed into service very often and is sometimes approached in Barabanki but is never called in Meerut. To explain it, we have to understand that Meerut is the most advanced region and Deoria is most backward region in our sample. It is a commonly accepted fact that in backward societies traditional leaders perform all kinds of functional requirements which is not so in advanced societies. This is substantiated by our data.

Table 3.11 provides information about extent of hiring of pumpsets and tubewells in sample villages. One thing which is very clear from the table is that the number of households hiring out pumpsets and tubewells is much less compared to those who are hiring them in. This is on account one or more than one of the following reasons : first, one household generally hires out his PTW/PS to more than one household. Second, those who are hiring it out are concealing this information. Third, the implement is being hired in from a neighbouring village as in case of Kusmauni. Fourth, those households who

are hiring it out have been left out from our village samples. This may also be true of the households who are hiring in pumping sets as in case of Misri Dhara. With respect to hiring out of PS (pumpset) vis-a-vis the ownership of the implement, it is maximum in Piprauli, followed by Babakpur and then Pakri Babu. With respect to hiring in the maximum proportion in relation to ownership is in Pakri Babu followed by Nagli Isa and then Piprauli. Pakri Babu is a STW village which hardly irrigates any village land. Rajputs who constitute 44 per cent of households are economically resourceful having large holdings and it is they who own pumping sets. The rest 56 per cent of households consisting of backward and scheduled castes possess very little land and in the absence of any satisfactory public irrigation system, they hire in pumpsets from the well to do Rajputs. In case of Nagli Isa and Piprauli, scheduled castes constitute 60 per cent and 46 per cent of the households respectively. They possess small landholdings and hire in pumpsets.

In case of tubewell, the highest proportion of those hiring out tubewell (vis-a-vis ownership) is in Kusmauni followed by Pakri Babu. In case of hiring in the highest proportion is in Pakri Babu followed by Kusmauni and then Nagli Isa. The reasons for high proportion in Pakri Babu and Nagli Isa are same which we mentioned with respect to pumping sets. The reasons for Kusmauni are slightly different. In Kusmauni a very large proportion of the households are marginal and small farmers and therefore, they cannot afford to have a PTW/PS. As a result,

there is lot of hiring in for supplementing canal irrigation which is very necessary in this village as it is a canal tail-end village.

A distinct feature emerging from the table is that a very large proportion of households own PTW/PS in STW villages, particularly in Darapur and Modkalan. In Pakri Babu although significant proportion of households own PTW/PS but not large enough to compare it with the other two STW villages. However, Pakri Babu tops in hiring in of PS as well as of PTW which means there is lot of area irrigated by these implements. The main reason of a smaller number of PTW and PS in Pakri Babu is that only Rajputs can afford it economically having the largest land-holdings. But others also need it, so they hire it in. All this indicates that STW is the most inadequate as a public irrigation system.

Table 3.12 gives the distribution of households owning pumpsets and tubewells by landholding and source of finance. As regard the ownership of the PS and TW, there is a positive relationship between PS and TW and landholding size except very marginally in case of very large land holding (above 10 ha.) with respect to TW. In the category of marginal farmers one household each owns a PS and TW. In the category of small, 6 per cent own PS and 2 per cent TW. In medium category 12 per cent own PS and 10 per cent TW. In large category PS owners are 21 per cent compared to 20 per cent TW owners. In the "very large" category, we find a slight decline in the proportion of those who own TW and it is reduced to 19 per cent

compared to 26 per cent PS owners. As a matter of fact, ownership of PS and TW starts with "small" landholding but the proportion of TW owners in the next higher landholding categories rise more sharply then PS owners and this trend continues upto "large" category. However, in the very large category TW owners' proportion gets reduced marginally but not that of PS owners. Overall 9 per cent of sample households own pumpsets while 7 per cent own tubewells.

With respect to financing there are mainly two sources i.e. one's own money and loan from the bank. The other sources, consisting, loan from the money lender, friend, relative, etc. are negligible and constitute 2 per cent in case of PS and 3 per cent in case of TW. One differentiating trend with respect to PS and TW is the proportion of the owners with respect to source of financing. In the overall sample, the largest proportion of PS owners (52 per cent) get it through bank loan and 46 per cent buy it with their own money. Opposite is the case of TW. Here 63 per cent of owners buy it with their own money while 34 per cent get financed by bank. Let us see what is the trend with respect to different landholding categories. Starting with the PS, we find that in the category of small and medium 52 per cent and 62 per cent respectively obtain a PS with their own resources, while in the large and very large (above 10 ha.) categories 69 per cent and 59 per cent get it through bank loans. In case of TW, we find in majority of cases in all categories it is obtained by a farmer with his own money. But strangely and for some unexplicable reasons the largest proportions of those owning a tubewell by their own

money are to be found in the very large land holding category (above 10 ha.) where 86 per cent of households obtain it with their own money followed by 78 per cent in case of small and then 56 per cent each in case of medium and large categories. This table, thus, indicates that very small farmers do not own either a PS or a TW. Many middle range farmers own these but more often then not they buy it with their own finances. The big farmers obtain bank loans for possessing these irrigation implements while very big farmers again go for self-financing.

CHAPTER IV

Performance of Irrigation Systems

In chapter 3 we dealt with various types of irrigation systems which emerged in nine sample villages surveyed by us. In the present chapter we intend to examine the performance of the various irrigation systems. The examination, in particular will be in considerable detail with respect to two public irrigation systems - the canal and the state tubewell. In case of canal comparison will be attempted with respect to head-reach and tail-end villages. Attempt would also be made to examine some aspects of private irrigation systems - private tubewells, including pumpsets and traditional irrigation modes. Performance will be examined in terms of interaction of irrigation technology, agriculture technology and social factors. In addition, the performance will also be examined in relation to evaluations made and opinions expressed by the surveyed respondents about the various irrigation systems.

Tables 4.1, 4.2 and 4.3 are based on the questions asked by us from our respondents in nine villages concerning their three most important crops. These tables are supposed to indicate how efficient is the agriculture run under different irrigation systems. The indicators used are cultivation of three important crops (wheat, paddy and sugarcane) in terms of - (a) structure of inputs; and (b) productivity. It is expected that better irrigation systems are characterised by better and higher level of inputs per acre resulting in higher productivity.

Wheat

The table 4.1 indicates that the largest area under wheat (422.3 acres) is being grown by the households using the combination of CNL + PTW followed by those using CNL (376.7 acres) and then PTW (195.5 acres). The maximum average yield per acres in 9.3 quintals brought out by households using the combination of CNL + PTW. The same one using the largest amount (13.3 kg.) of HYV seeds per acre, although lowest amount of local and improved local seeds (36.4 kg. per acre). They are also using the largest amount of fertilizers (81.3 kg. per acre. One reason why households under CNL + PTW are using high quantity of HYV seeds is that they have the most assured supply of water because they use PTW to supplement canal irrigation or vice versa. As a result, if canal water fails or is inadequate they use PTW. Greater use of HYV seeds and fertilizers is possible for the households, because of certainty of irrigation. Actually HYV seed and fertilizer combination is very sensitive to adequate and timely irrigation and would not be useful in less certain irrigation.

Next position in terms of productivity and also in terms of area under wheat crop is occupied by the households using CNL irrigation. Although CNL and PTW both have an average yield of 8.2 quintals per acre but the wheat area under PTW is only 196 acres compared to 377 acres under CNL. With respect to the use of seeds per acre, there is not much difference between the two as CNL households are using 49 kg. per acre and PTW households are using 51.7 kg. per acre. However, when

we examine the use of HYV seeds and fertilizers, we notice a change under the two systems : CNL households use less HYV seeds (5.2 kg/acre) and more fertilizers (77.6 kg/acre) compared to it PTW households use more HYV seeds (9.3 kg/acre) and less fertilizers (68.9 kg/acre).

The overall productivity of wheat in our sample villages is 8.3 quintals per acre with a use of 42.6 kg. per acre local and improved local seeds and 8.4 kg. per acre HYV seeds, making it a total of 51 kg. per acre. The use of fertilizer comes to 75.8 kg. per acre. Actually there is no uniform dose of fertilizers to be used in all areas. The dose varies according to soil conditions. However, Fertilizer Corporation of India has prescribed a standard dose of the use of chemicals at the all India context which gives a very general and broad guide. According to it the standard dose of the fertilizer is 80 kg. per acre for wheat which is slightly more than our average. The productivity of irrigated wheat in a study of U.P. conducted by NCAER comes to 7.2 quintals per acre for traditional wheat and 7.9 quintals per acre for the HYV.[1] Another source gives the productivity of wheat for U.P. as 6.6 quintals per acre and 6.7 quintals per acre for India for the year 1980-81.[2] Our average of 8.3 quintals per acre for the sample households is higher than both.

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[1]Contribution of Irrigation to Agricultural Production and Productivity, National Council of Applied Economic Research, New Delhi, 1983, pp.17-18, (mimeo).

[2]Agricultural Statistics of U.P., 1980-81, Director, Agricultural Statistics, Directorate of Agriculture, U.P., Publication No.72, December 1982, p.116 (in Hindi).

Paddy

The first thing about table 4.2 is that it does not have the category of STW. The reason for the elimination of STW category was because there was only one household under STW having a very insignificant area under paddy crop. It is clear from the table that HYV seeds are used more by households using PTW whether alone (4.5 kg/acre) or in combination with TRD (9.6 kg/acre) or STW (6.5 kg/acre). As regards the use of fertilizer it is found to be highest among the households using CNL + PTW (75.4 kg/acre), followed by CNL (69.9 kg/acre). However, when we examine the average yield figures under various systems we find the highest average yield figures are to be found in CNL (9.2 quintals/acre). The households using CNL no doubt, use substantial amount of fertilizers (second highest) but are using very meagre amount of HYV of seeds (1.5 kg/acre) which is even lower than the overall average. Even the total seeds used are below the overall average. This obviously speaks about the good performance of CNL as an irrigation system. The next two highest average yield figures are reported in CNL + PTW (8.7 qtls/acre) and PTW (8.3 qtls/acre). The households employing these irrigation modes are using substantial amount of fertilizers and HYV seeds. The consequence of such increased use of HYV seeds and fertilizers in such households is reflected in the average yield figures which are the second and the third highest after CNL.

The table also indicates that the first three largest areas under paddy crop belong to the households who are using canal water alone (251.2 acres) and in combination with PTW (138.3 acres) and TRD (65.6 acres). This means not only canal water has the best performance in terms of yield but also it is all pervasive.

The overall productivity of paddy in our sample villages is 8.8 quintals per acre which is obtained by using 3.1 kg/acre HYV seeds (25.9 kg/acre in all) and 67 kg/acre fertilizers. The standard does of the use of chemicals in all India context prescribed by Fertilizer Corporation of India is 58 kg/acre for kharif paddy. The productivity of paddy in our sample areas is much higher than the figures of 4.3 qtls/acre for U.P. and 5.4 qtls/acre for India.[1]

Sugarcane

Table 4.3 clearly indicates the similar pattern with respect to area under sugarcane crop which we found in case of wheat (table 4.1). The largest area under sugarcane (286.6 acres) is also being grown by the households using CNL + PTW, followed by those using CNL (154.3 acres) and then PTW (56.4 acres). The table clearly shows that the largest amount of HYV seeds are used by households using CNL alone or in combination with PTW and TRD. It's use in case of CNL is 162.1 kg/acre, in case of CNL + TRD is 129.7 kg/acre and in case of CNL + PTW is 116.5 kg/acres. As regard, the use of fertilizer, it is found to be highest (157.8 kg/acre) among households

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[1]Agricultural Statistics of U.P., 1980-81, op. cit., p.116 (in Hindi).

using STW, followed by PTW (150.8 kg/acre) and then CNL + PTW (130.1 kg/acre). In terms of average yield the highest yield of 202.5 qtls/acre is obtained by households using the combination of CNL + PTW. This is really remarkable considering the fact its place is third in the use of HYV seeds as well as fertilizers. The possible reason for this kind of performance by households using this combination is that they have the most assured irrigation because in case of failure of CNL they can use PTW and vice versa. The second highest yield of 159 kg/acre, which is considerably lower compared to the first is obtained by the households using CNL whose place is first in the use of HYV seeds (162 kg/acre) but fourth (125 kg/acre) in the use of fertilizers. The third highest yield of 128.7 kg/acre is obtained by the households using the combination of CNL + TRD. They are using substantial amount of HYV seeds (129.7 kg/acre) but very meagre amount of fertilizers (69 kg/acre).

The overall productivity of sugarcane in our sample villages is 172.6 qtls/acre which is obtained by using 117.9 kg/acre HYV seeds and 127.6 kg/acre fertilizers. The productivity of sugarcane in our sample villages is lower than the sugarcane productivity of 190.6 qtls/acre for U.P. and 230.1 qtls/acre for India.[1]

An important aspect of the performance of irrigation systems is the source-wise productivity. Dhawan has analysed this aspect with the help of regression analysis of the secondary

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[1]Agricultural Statistics of U.P., 1980-81, op. cit., p.127 (in Hindi).

data. Talking about U.P., he points out that the striking thing about the source-wise productivity is that, ground water is not superior to canal irrigation and tubewell (private + state) irrigation turns out to be only a shade superior to canal irrigation. He thinks that private tubewell irrigation is far superior to canal irrigation though he is unable to demonstrate it with the help of secondary statistics since official data of tubewell irrigated area are not compiled separately for the two categories of tubewells.[1]

NCAER study which had a large sample, drawn from each district of U.P. also points out that no superiority of any particular source of irrigation in raising productivity emerged from their analysis.[2] Our own study indicates the superiority of canal irrigation in comparison to other single sources. However, the combination of canal and private tubewell (including pumping set) appears to be best sub-system of irrigation.

Table 4.4 examines the adequacy and the regularity of canal water in head and tail villages under Gandak, Sharda Sahayak and Upper Ganga systems. For a proper measure of adequacy and regularity we have constructed two indices one each for adequacy and regularity. We had asked all our sample respondents about the adequacy and regularity of water during kharif, rabi and Zaid on a three point scale consisting of adequate, somewhat adequate and inadequate for adequacy of canal water and regular,

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[1] B.D. Dhawan : Source-wise Productivity Impact of Irrigation: A State-wide Analysis, Institute of Economic Growth, Delhi, October 1983, p.36 (mimeo).

[2] Contribution of Irrigation to Agricultural Production and Productivity (see Summary of Findings, p.2), NCAER, 1983, op. cit.

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somewhat regular and irregular for the regularity of water supply. In both the cases weightage was gives in a descending order, i.e., 3, 2 and 1. For instance if a respondent said that the canal water was adequate for kharif somewhat adequate for rabi and inadequate for Zaid, his total scores would be 3 + 2 + 1 = 6. The same pattern was adopted in the case of regularity index. Thus, the values in the indices would range between 1 (inadequate/irregular) and 3 (adequate/regular).

Taking the adequacy index first, we find, in general, the head-reach villages have higher scores compared to tail-end villages. In addition, the level of adequacy is much higher in kharif and rabi compared to Zaid in both head-reach as well as in tail-end villages. Among the villages adequacy is highest in Gandak system in both head and tail-end villages and is lowest in Sharda Sahayak system among the head-reach villages. Among the tail-end villages and during kharif and rabi, it is Upper Ganga which is lowest although during Zaid bottom place goes to Sharda Sahayak.

Judging the canal supply in terms of regularity, we find the supply is much more regular in head-reach villages in comparison to tail-end ones. In addition, the regularity is wore off in Zaid compared to kharif and rabi and it is more marked in case of tail-end villages. Among the villages, regularity is highest in Gandak system in both head as well as tail villages and is worst in Upper Ganga system during kharif and rabi. Things are no better in Sharda Sahayak during Zaid. The general picture which emerges from the table is that

Gandak system serves best the requirements of adequate and regular water supply. The next place is obtained by Sharda Sahayak, although with respect to adequacy among head-reach villages and adequacy and regularity during Zaid both in head-reach and tail-end villages of Upper Ganga score higher points than Sharda Sahayak relegating it to the third place.

In the event the respondent felt that the supply of water through canal was inadequate or irregular, we asked him the reasons as to why it was so. Table 4.5 gives an idea of the reasons for the inadequacy and/or irregularity of canal water. The first thing which strikes in the table is that a much lower proportion of users of canal water have responded to this question. In case of Gandak system, 26 per cent in head and 39 per cent in tail villages have responded to the question. In Sharda Sahayak 44 per cent in head and 55 per cent in tail have assigned the reasons. In case of Upper Ganga, 54 per cent in head and a very large proportion (80 per cent) have responded to the query. If response to this question is any indication of the performance of a particular canal system with respect to adequacy and regularity of its water supply, surely Gandak tops the list and Upper Ganga finds a place at the bottom, with its tail-end villages farming worst.

The most often mentioned reason for the inadequacy and/or irregularity of water in head as well as in the tail villages is "short supply in the outlet" which is mentioned by 37 per cent head-reach and 34 per cent tail-enders. The second most

important reasons for the head-reach farmers are, (a) hindrance by upper reach farmers and (b) location of the field at the end of the out-let. In both cases 22 per cent respondents mentioned these two reasons. In case of tail-end villages "(a)" again is the second most important reason mentioned by 29 per cent of farmers and "ill maintenance of canal structures" is the third most important reason mentioned by 16 per cent of respondents. Apart from these, some villages have their unique problems, for instance, 15 per cent farmers in Misri Dhara and 25 per cent in Kusmauni (both in Gandak) complained that their plots were at a higher level than the canal outlet.

Table 4.6 examines the adequacy and regularity of STW water in three villages where this system operates. As in case of canal here also, we have constructed the indices of adequacy and regularity using the same procedure adopted in case of table 4.4. Taking the adequacy of the water first, we find in general the adequacy scores are poor in all STW villages and are poorest in case of Pakri Babu. Among the three villages, Darapur has the best scores. In all villages, adequacy scores are highest in kharif, followed by rabi and are very low in case of zaid. With respect to regularity, Modkalan scores the highest point and Pakri Babu again is at the bottom. As regard the three cropping seasons, the trend is same as we found in case of adequacy with the exception that margine differences exist in the scores of kharif and rabi, never the less, zaid lags far behind and has the lowest score. If we compare the adequacy and the regularity of canals (see table 4.4) with that of STW, it is obvious that STW supply is far more inadequate and irregular compared to that of canals.

With respect to reasons (see table 4.7), 53 per cent of respondents have mentioned that the irregular and rare supply of electricity is the main cause of inadequacy and irregularity while 25 per cent respondents mention that the STW is out of order most of the times. Another 12 per cent have mentioned ill maintenance of the irrigation channels as the main reason for the existing state of affairs. In all the three villages, irregular supply of electricity was mentioned, as the main reason although with a varying percentage. In Modkalan it was 73 per cent, in Pakri Babu 48 per cent and in Darapur 37 per cent. In case of Pakri Babu and Modkalan ill maintained irrigation channels is mentioned as the second most important reason with 29 per cent and 15 per cent of respondents making a mention of it in Pakri Babu and Modkalan respectively. In case of Darapur, the second most important reason mentioned by 59 per cent of respondents is that the STW is out of order most of the time. A remarkable feature about Modkalan STW is that none of the respondents have complained about its being out of order. Another important point about Modkalan is that 12 per cent of respondents, particularly scheduled castes, have complained that the Jats, the dominant caste of the village do not allow them to take water from the STW.

In case of public irrigation systems, i.e., STW and canal, irrigation charges are collected from the user farmers on the basis of assessment of irrigated area by field level Irrigation Department staff like Patrol, Amin, Ziladar etc. To know what the user farmers felt, we asked them about the correctness of

irrigation assessment. Table 4.8 presents their opinion with respect to canal head-reach and tail-end villages. About 58 per cent of user farmers in all canal villages feel that the assessment is generally correct while 17 per cent feel the assessment is generally incorrect. In between these two views 25 per cent feel that the assessment is sometimes incorrect. However, there is a clear cut difference in the opinion of farmers in the head-reach and tail-end villages. Greater proportion of farmers in the tail-end villages question the correctness of assessment. In head-reach villages 63 per cent farmers mention that the assessment is generally correct while in the tail-end villages 51 per cent mention so. In the head-reach villages 15 per cent mention that the assessment is generally incorrect in tail-end villages 20 per cent mention so. Similarly, in head-reach villages 21 per cent think it is sometimes incorrect but 29 per cent think so in tail-end villages. Among the head-reach villages it is Piprauli which tops the list with 75 per cent of respondents mentioning the assessment is generally correct so followed by Misri Dhara (65 per cent) and then Babakpur (52 per cent). Among the tail-end villages, on the other hand, Fatahabad tops the list with 70 per cent of the respondents mentioning that the assessment is generally correct, followed by Nagli Isa with 44 per cent and Kusmauni with 41 per cent. The overall impression we gather from the table is that, Sharda Sahayak system is best in terms of correctness of assessment, followed by Gandak and then Upper Ganga.

The same aspect has been examined in relation to STW in table 4.9. The first thing which strikes about the table is that the opinion of STW water uses about the assessment is more negative compared to canal villages. Here 24 per cent think that it is generally incorrect (17 per cent in canal), 36 per cent think it is sometimes incorrect (25 per cent in canal) and 40 per cent think it is generally correct compared to canals 58 per cent. In terms of correctness of assessment, Darapur tops the list, followed by Modkalan and Pakri Babu finds a place at the bottom.

In case the assessment was sometimes/generally incorrect we asked our repondents the reasons behind it. The number of the respondents who gave reasons were even fewer than those who mentioned that the assessment was incorrect, therefore, we have not presented the data in a tabular form. However, to get an idea of their thinking we would make a brief discussion on the matter. In both kind of systems - the canal and the STW, the respondents have generally mentioned two reasons for the incorrect assessment and these are : "assessment without field visit" and "officials' expect bribe". In case of canal irrigated villages 77 per cent mentioned that the assessment was incorrect because the field officials made the assessment without the field visits, while 19 per cent mentioned that the officials expected bribe. However, there were significant differences between the head and the tail villages in this respect. In head-reach villages 72 per cent respondents mentioned that the assessment was without the field visits while 85 per cent thought so in case of tail-end villages. Similarly, with respect

to bribe 23 per cent respondents in head-reach villages thought that the officials expected bribe while in case of tail-end only 12 per cent thought so.

With respect to STWs 87 per cent thought that the assessment was incorrect because it was made without the field visit while 13 per cent thought it was so because officials' expected bribe. In Modkalan, Darapur and Pakri Babu, 100, 95 and 59 per cent respondents respectively made a motion that incorrect assessment was because it was made without field visists. In case of Pakri Babu a major portion of respondents (53 per cent) thought that the assessment was incorrect because the officials expected bribe. With respect to bribe, a much lower proportion of STW water users make a mention of it (13 per cent) as a reason for incorrect assessment compared to canal water users (19 per cent). This is so because there is another avenue of making money by officials in case of STW. It happens when the motor of a STW burns out it is not replaced by officials unless a handsome amount is contributed by water users for which each has to contribute his share according the area of the land irrigated by him.

Some of the questions we asked our respondents pertained to the kind of problems they faced in the delivery of water, whom they approached for solving the problem and the outcome of their efforts. The data concerning these questions have been presented in table 4.10 to 4.15. Let us start first with the problems faced by the users in the delivery of canal water in head-reach and tail-end villages. The table 4.10 clearly

indicates that 62 per cent of the respondents do not mention any problem in all the canal villages taken together. The first problem which is faced by the respondent is the problem of inadequate/irregular supply of water which is mentioned by 20 per cent of the respondents. It is followed by the problem of defective canal structures or break down in canal structures which is mentioned by 8 per cent water users. Another 6 per cent mention the problem created by upper reach farmers by breaking of structures and illegal diversion of water. However, there are significant differences in certain areas between head and tail systems. The most significant difference is to be found in case of defective canal structures or break down in canal structures. In head-reach villages 4 per cent users mention it as a problem, while in case of tail-end 15 per cent make a mention of it. The qualitative difference between head and tail water supply emerges from the fact that in head-reach villages 72 per cent users say that there are no problems. In tail-end villages, on the other hand, 46 per cent mention that there are no problems. However, with respect to breaking of structures and illegal diversion of water, there are no differences between head and tail villages in both cases it is mentioned as a problem by 6 per cent of users. Among the head-reach systems, Gandak appears to be the best canal served system with 81 per cent users making no mention of any problems followed by Sharda Sahayak and then Upper Ganga. In case of tail-end systems Sharda Sahayak obtains first position followed by Upper Ganga and then closely on its heels is Gandak system.

An examination of the problems of delivery of water under STW system reveals that the most important problem here is rate supply of electicity (Table 4.11). It has been mentioned by 25 per cent of users followed by the problem that the STW remains out of order most of the time (23 per cent), bad condition of irrigation channels (21 per cent), STW out of order/ electricity not available (19 per cent) and plots of the farmers being too far from the STW (9 per cent). However, each STW has its unique problem. In case of Pakri Babu the biggest problem is bad condition of irrigation channels (51 per cent) followed by plot being far off from the STW (26 per cent). Actually, Pakri Babu village is irrigated by a STW which irrigates four other villages and Pakri Babu cultivated land is far off from the STW. The STW is over twenty years old and the field channels have not been maintained for the last several years. As a result of all these factors two mentioned problems arise. In case of Darapur, the problem on account of STW being out of order is mentioned by 54 per cent users. The second problem is, either the STW is out of order or the electricity is not available when STW is alright or when electricity is available the STW is out of order. Thus, these two problems combined together have been mentioned by as many as 86 per cent of the users and if we add "rare supply of electricity" to it, 93 per cent users are affected by these problems. In case of Modkalan, rare supply of electricity is the biggest problem and has been mentioned by 61 per cent of users. A unique problem mentioned by 11 per cent users here is that Jats, the dominant caste of the village, do not allow other castes, particularly the scheduled castes to take STW water for irrigation.

Table 4.12 presents the data pertaining to the agency/ the officials approached by the users for rectifying the problems in head-reach and tail-end canal villages. In the overall sample, 38 per cent of users replied to our query and of those who replied 62 per cent mentioned that they did not approach anyone. For solving their problem, 12 per cent approached the Executive Engineer, 11 per cent met the Patrol, 5 per cent met the Overseer, 4 per cent approached the SDO (Assistant Engineer) and 7 per cent approached "others". In the head-reach system, in Gandak the largest proportion (25 per cent) approached the Patrol, in Sharda Sahayak it was the SDO who was most often (10 per cent) approached and in Upper Ganga it was the Executive Engineer who was approached by maximum users (6 per cent). Among the tail-end systems, in case of Gandak the highest proportion of respondents (22 per cent) approached "others" (Deputy Revenue Officer, BSA, Village Pradhan). In case of Sharda Sahayak the largest proportion (31 per cent) met the Executive Engineer. In Upper Ganga the largest proportion (18 per cent) consisted of those who met the Overseer/the Ziladar. In table 4.13 data about the outcome of approaching the agency/the officials in canal head and tail villages is presented. Overall, about 95 per cent of the respondents reported that no help was rendered to them by the officials whom they approached. In 4 per cent cases the officials did make an effort to solve their problem but the problem was not solved. Thus, effectively no positive outcome came in about 99 per cent of cases. Only in one case, out of 72 (Gandak, tail-end) the problem was solved by official efforts. In Gandak tail-end (Kusmauni) again in two cases, the official made efforts but the problem was not solved.

Table 4.14 presents data about the agency/the officials approached for rectifying problems concerning STW. In the overall sample in all the STW villages, 68 per cent users did not approach anyone. The largest proportion (23 per cent) of users approached either the Amin or the Operator followed by those who approached Executive Engineer (5 per cent) and then 3 per cent approached "others", particularly the Village Pradhan. However, what is intriguing is that out of 41 users who approached some or the other, only one approached Ziladar. With respect to individual STWs, there are some variations. In Modkalan the largest number of users met either the Operator/the Amin or the Executive Engineer (7 per cent in each case). In case of Darapur and Pakri Babu the largest number of users approached the Operator/ the Amin. The percentage for the former being 36 and for the latter 27. In table 4.15 we have presented the data concerning the outcome of approach with respect to STW. Here also, the position is no different than what we found in case of canal. Out of the 41 cases in which an approach was made to officials for rectifying the problem, in none of the cases the problem was solved by the official efforts. In case as Darapur, the officials did not even render any assistance, only in one case in Modkalan and 3 cases in Pakri Babu officials did make efforts but the problem remained unsolved.

As a matter of fact, the data presented in tables 4.12 to 4.15 speak volumes about job performance of the officials. In this respect, there is no difference among the officials - whether they are in canal systems or in STW. Similarly, no

differences are noticeable in head-reach and tail-end systems as well as between the systems covered by Command Area Development Programme and the system which is not covered by the programme.

Table 4.16 presents data concerning users' knowledge of the offices of different canal and CADA functionaries. Starting with the Executive Engineer (EE), we find that in Gandak and Sharda Sahayak systems in the tail-end villages many more users have the knowledge of the office of EE compared to the head-reach village users. In Gandak and Sharda Sahayak tail-end villages 41 and 32 per cent users respectively know his office compared to 9 and 14 per cent respectively in Gandak and Sharda Sahayak head-reach village users having knowledge of his office. However, things are different in case of Upper Ganga system where 41 per cent head-reach village users know his office compared 36 per cent tail-end village users. In case of Assistant Engineer, about 30 to 36 per cent know his office in head and tail villages in Gandak and Upper Ganga systems. In Sharda Sahayak system, however, fewer users know his office and among those who know their proportion varies significantly between head (15 per cent) and tail (24 per cent). Although the trend with respect to knowledge among users of head and tail villages in three systems is same as in the case of EE but the variation is less, particularly in Gandak system. In case of Junior Engineer (JE) more users know his office in Gandak and Upper Ganga head-reach villages. On the other hand, more users of tail-end village of Sharda Sahayak have the knowledge of his office. A very meagre proportion of users know about the office of Deputy Revenue Officer (DRO) in Gandak and Sharda Sahayak systems although, more know it in head-reach than in tail-end

villages. No particular trend is visible in case of Ziladar. Although, the data does not provide any clear cut pattern but it does indicate, with some exceptions, that in Gandak and Sharda Sahayak systems, more users of tail-end villages know the offices of the staff compared to head-reach users. In case of Upper Ganga system, no such differences exist between the head and the tail. The reason may be, Upper Ganga is a very old system and the users know about the various offices concerning canal. This is reflected in the fact that in Upper Ganga system, in comparison to the other two systems, a much higher percentage of users know the offices of various functionaries. Differences in the knowledge of users in the head and the tail in the other two systems may be on account of the reason that the tail-enders are facing more problems concerning water delivery than the head-reach users, so, at least they know the offices of the various functionaries. But in case strict "Warabandi" prevailing in Upper Ganga the problems are equally faced by the head and the tail users of the canal water.

With respect to CADA staff which is posted in Gandak and Sharda Sahayak commands only, there are clear cut differences about the knowledge of the staff between head and tail users. However, unlike the irrigation staff, generally more users in head reach villages know of their office than users in the tail-end. The other thing which strikes in the table is that a very small proportion of users know about the offices of various staff, including CADA staff. The only exception in this respect being Upper Ganga system.

The evaluation of the canal field staff by the users has been brought out in table 4.17. The evaluation has been confined to the field staff who are supposed to have maximum interaction with the beneficiary farmers. Therefore, the work of Amin and Patrol has been evaluated by the users of canal water. We intended to include the evaluation of CADA field staff also but in our data we found over 90 per cent of water users had said they did not know about their work, therefore, their evaluation was left out. In case of Amin a very large proportion of users said they did not know how they did their work. In Gandak, 60 per cent head-reach and 78 per cent tail-end users said they did not know. Only in case of the head-reach village of Meerut a small proportion (4 per cent) told they did not know about his work. Of those who evaluated his work, a large proportion said he did good or fair work. In case of Patrol the proportion of "do not know" has dwindled down, highest being 41 per cent in Nagli Isa and lowest was 3 per cent in Babakpur. Compared to Amin a high proportion of users thought he did not do good work. The proportion varying between 21 per cent in the tail-end village of Sharda Sahayak 49 per cent in the head-reach village of Upper Ganga. However, a clear cut pattern does emerge in case the evaluation is "good". This is not only so in case of Patrol but also in case of Amin. In all three irrigation systems a greater proportion of head-reach users have mentioned their work as "good" compared to tail-end users, although there are distinct variations in the proportion in the head and the tail of three canal systems.

Table 4.18 examines the knowledge of the STW water users concerning the offices of various STW functionaries. An important point which emerges from the table is that among all STW water users, the Pakri Babu farmers are most informed about the offices of various functionaries and Darapur farmers are the least informed ones. We had asked about the offices of five functionaries and in case of all of them, except Deputy Revenue Officer (DRO), the percentage of users knowing the office is highest in Pakri Babu. In case of DRO, Modkalan water users come first and in case of rest of the functionaries Modkalan water users come second. Darapur farmers always remain poor third. It seems the knowledge about the offices of STW staff is positively linked with the rate of literacy. In our sample, Pakri Babu with 50 per cent literacy rate tops all the districts while Darapur with 23 per cent literacy rate is at the bottom of our sample villages (see table 2.2). Among the functionaries the Assistant Engineer is most well known by water users, followed by Executive Engineer, Junior Engineer, Ziladar and Deputy Revenue Officer in that order.

Table 4.19 presents the evaluation of STW field staff who are supposed have maximum interaction with the users of STW water, hence Amin and operator have been evaluated by those farmers who take water from the STW. In case of Amin, there is a large percentage of users who did not evaluate his work. The percentage is particularly high in case of Darapur. The same trend was found in case of the canal Amin. The work of the Amin is most appreciated in Modkalan, followed by Pakri Babu and then Darapur. In case of operator a considerable proportion

of users mentioned that they were not in a position to evaluate the operator's work, however, the proportion is not as high as in case of the Amin. The operator's work is most appreciated in Darapur, followed by Modkalan and then Pakri Babu.

After obtaining all types of informations, opinions and evaluations from the users of public irrigation systems, we asked the users to give suggestions which would ensure better utilisation of water from these sources. Table 4.20 examines this aspect with respect to canal systems. In case of canals, there are in all 555 users of canal water (64 per cent of the sample) and out of those who have responded to our query with respect to suggestions are 496 users (89 per cent). Among them the largest chunk (60 per cent) consists of those who replied that they did not have any idea in this respect. The largest number of users (9 per cent) suggested that there should be provision of field channels, followed by those who thought sincere attitude on the part of irrigation staff was necessary (6 per cent). 5 per cent thought that there should be arrangement of control structures and another 5 per cent were of the view that there should be closer proximity between outlet commands and outlet capacities. Proper maintenance of canal structures was stressed by 4 per cent users. 8 per cent of the users mentioned various others suggestions which in order of ranking are : proper "osrabandi", adequate and regular supply of water and alteration in canal structures where they are defective.

In table 4.21 the suggestions offered for better utilisation of STW irrigation by user households have been dealt with. Here also a large proportion (44 per cent) of users said they had no idea about the suggestions. Overall, the highest proportion (28 per cent) of respondent stressed the repair and proper maintenance of irrigation channels. Next in proportion were those who emphasised more regular electric supply (20 per cent), followed by 6 per cent of users who stressed that the staff should do their work sincerely. In Pakri Babu and Darapur, repair and maintenance of irrigation channels was emphasised by the largest proportion of users. In case of Modkalan the largest proportion of users laid emphasis on more regular supply of electricity and the second largest number of users suggested "repair and maintenance of irrigation channels". On the other hand, more regular supply of electricity was emphasised by the second largest number of users in Pakri Babu and Darapur.

The most important aspect of public irrigation systems is its distributive justice. The question which is of prime importance is : Do all get same benefits from the public irrigation systems? If no, who are the maximum beneficiaries and what socio-economic groups they represent. This question has been examined by other scholars also. In his study of Bhakra, Reidinger says that, "It was commonly noticed that the holdings of the large and more powerful landlords often were closest to the head of the water course".[1] Pradhan in his Kosi study

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[1] R. Reidinger, Canal Irrigation and Institutions in India : Micro Study and Evaluation, Ph.D. thesis in Agricultural Economics, Duke University, 1971.

points out that, "Evidently the biggest size group (of land holders) get the maximum irrigation facility (i.e., maximum proportion of land irrigated), substantiating probably the power theory of distribution."[1] Pandey and Muthana's findings corroborate the findings of earlier two studies when they say, "The class of poor peasantry fare very badly with regard to irrigation, 57.7 per cent of their area sown is under irrigation, which is much lower than the overall average of 66.9 per cent. The situation is same when we come down to the individual village level. It is the class of poor peasantry which has always the lowest percentage of irrigated acreage as compared to the other classes of households."[2] However, Pandy in his later study of Virul-Chandan-Badua Command Area makes two conclusions. First, that among the various irrigation sources, canal is more equitable in providing benefit to various categories of cultivation. Second, the upper two categories of cultivation land owning class (5-10 acres and 10 acres and above) are greater beneficiaries of available from either surface or sub-surface water.[3]

The issue concerning the beneficiaries of public irrigation systems - canal and STW has been examined by us in relation to land holding size and caste. Table 4.22 presents land holding-wise area irrigated by purely public irrigation systems and not

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[1]Pradhan H. Prasad : Economic Benefits of Kosi Area, ANS Institute of Social Studies, Patna, 1976, p.34 (mimeo).

[2]M.P. Pandey and Ann Muthana : Sone Command Area : A Socio-Economic Survey, ANS Institute of Social Studies, Patna, 1976, p.34 (mimeo).

[3]M.P. Pandey : The Impact of Irrigation on Rural Development, A Case Study, Concept Publishing Company, New Delhi, 1979, p.44.

in combination with any source or mode. A casual glance over the table makes it amply clear that there is a positive relationship between the size of land holding and the area irrigated by purely public irrigation systems. This relationship remains so until we reach the land holding size of above 10 acres. There are 19 per cent "marginal" households in our sample but their share in the public irrigated area is 8 per cent. "Small" households constitute 42 per cent and their share in public irrigated area is 24 per cent. In case of "medium" 21 per cent household enjoy 25 per cent of irrigated share while large constitute 18 per cent households and have 43 per cent of share in the area irrigated by purely public irrigated systems. The table also shows that as we go up higher in the land holding ladder, the average area irrigated by purely public irrigation systems goes on increasing. The average area is 0.9 acre for "marginal", 1.2 acre for "small", 2.7 acre for "medium", 4.3 acre for "large" (5.01 to 10 acres) and 9.4 acre for "very large" (above 10 acres). Thus, our data clearly demonstrates that the benefits of public irrigation systems are skewed in favour of bigger land owning classes.

Table 4.23 gives caste-wise area irrigated by purely public irrigation systems. In this table as in 4.23 we have left out the area irrigated by canal in combination with other sources and also area irrigated by STW in combination with other sources. Thus, we have taken only the area irrigated purely by these two public irrigation sources. The table shows that 5 per cent Brahmin households contain a share of 9 per cent area irrigated by public irrigation systems, while 11 per cent Rajputs get a

share of 17 per cent public irrigated area. In case of Jats/ Gujjars 16 per cent households enjoy a share of 25 per cent irrigated area. The backward castes, Yadav, Koiri and Kurmi being 30 per cent in our sample get a share of 28 per cent of irrigated area, while the other backward castes constituting 11 per cent households enjoy 7 per cent share of irrigated water. In case of scheduled castes, the share of public irrigated area is 14 per cent and their proportion in the sample households is 25 per cent. The trend which clearly emerges from the table is that lesser proportion of higher caste households in our sample enjoy greater percentage of public irrigation. This is so in case of Brahmins and Rajputs. Although Jats and Gujjars are not high castes but they also do very well with respect to public irrigation. But as we come to backward castes and scheduled castes the trend turns into a reverse order. This reverse trend is minimal in case of the backward castes of Koiri, Kurmi and Yadav but goes on increasing speedily in case of other backward and scheduled castes. As far as average irrigated area per household by public systems is concerned, Brahmins with 3.7 top the list, followed by Jats and Gujjars (3.4), Rajputs/Brahmins (3.3), Yadavs, Koiris, Kurmis (2.1), other backward castes (1.3) and scheduled castes (1.2).

So far we have been talking about the performance of two public irrigation systems, namely canal and STW. In addition to these public irrigation systems, we have also examined the two private irrigation systems, namely private tubewell which includes pumpsets and traditional systems. In case of private irrigation systems, the examination is not as detailed as we had

done in case of public irrigation systems. As a matter of fact, in case of traditional systems the examination is minimal.

Table 4.24 provides details concerning private tubewell irrigation which includes pumpsets. An examination of households owning PTW in relation to total number of households in sample villages reveal that the highest proportion of households owning PTW is in Darapur with 35 per cent of households owning PTW, followed by Modkalan with (34 per cent), Fatahabad (18 per cent), Nagli Isa (16 per cent), Babakpur (15 per cent) and Pakri Babu (14 per cent). At the bottom is Misri Dhara with 2 per cent preceded by Kusmauni with 4 per cent of households owning PTW. The PTWs are minimal in head-reach canal villages and are maximum in STW villages in each district. This means that STW water supply is so irregular and inadequate that most of the households go in for having their own PTW. The district-wise pattern indicates that Meerut with 21.4 per cent households owning PTW is at the top, followed by Barabanki with 20.5 per cent and at the bottom is Deoria with 6.3 per cent of the households owning PTW.

If a household owns a PTW, it does not mean that he alone irrigates from it. He invariably hires it out to others for irrigation. This is clear from the table that while only 138 households in our sample own a PTW 517 households use it for irrigation. It means that about 4 households are irrigating per PTW in our sample villages. The largest number being in Kusmauni where about 14 households were irrigating per PTW, followed by Pakri Babu with 7 and Nagli Isa and Fatahabad with 4 each. This

indicates that it is the tail-end villages (except Pakri Babu) hwere a PTW is used by maximum number of households. This substantiates the generally prevailing notion that there is short supply of water in tail-end canal villages.

An indicator of how effectively a PTW is being used is how much area is irrigated per PTW? From this angle Pakri Babu tops the list of sample villages with 27 acres of area irrigated per PTW, followed by Kusmauni with 20 acres, Modkalan with 16 acres and Nagli Isa with 15 acres. The pattern indicates that the best utilisation of PTW, in terms of area irrigated per PTW, is taking place in STW villages or canal tail-end villages. In head-reach villages it is utilised to a minimal degree. The district-wise pattern shows that the best utilisation of a limited resource (PTW) is taking place in Deoria, followed by Meerut and then Barabanki.

The most important consideration in owning an asset is how cost effective that asset is. We have examined this aspect in table 4.25, where details about running cost of PTW in relation to land holding size have been presented. The table clearly shows an inverse relationship between the size of the land holding and per acre annual running cost. In case of marginal households the annual running cost per acre comes to Rs.237 which goes down progressively with the increase in land holding size and is Rs.206 for small, Rs.137 for medium, Rs.112 for large. Thus, we find the per acre running cost goes down by less than half in case of large holdings compared to marginal holdings. As a matter of fact, PTW is most economical asset for those who own above 10 acres of land.

We also asked those who were owning a PTW about the difficulties they faced with respect to fuel and electricity (Table 4.26). Out of the total number of 138 PTW owning households, the largest proportion (53 per cent) mentioned that rare and/or irregular supply of electricity was the main difficulty they faced in running a tubewell, followed by 36 per cent who mentioned scarcity of diesel or its availability at distant places was the main problem. 11 per cent mentioned that they did not face any problem. Scarcity of diesel was the main problem of the largest proportion of households in Darapur, followed by Fatahabad and then Pakri Babu. Rare and irregular supply of electricity, on the other hand, is the main problem of Modkalan, followed by Darapur and then Babakpur. The general pattern indicates that diesel and electricity related problems are most severely faced by either STW village users or canal tail-end users. The head-reach villages do not face these problems to that extent with the exception of Babakpur.

Apart from PTW the other system of private irrigation we examined was indigenous. The three types of traditional lift devices commonly used in our sample villages were, 'Dhekucha' (swing basket), 'Dhekuli'/'Dhenkli' (counterpoise-bucket lift) and 'Rahat' (persian wheel). Based on the optimum range in the height of lift, the first two may be grouped under low lift while the third may be put in the category of medium lift. A Dhekucha/Swing Basket consists of a basket or shovel like scoop to which four ropes are attached. Two persons stand facing each other and swing the basket to fill in water. The basket is raised and discharged into the field channel. Through

Dhekucha farmers fetch water from canal ditches, chakouts ponds and tanks but we found it was most commonly used by farmers to lift canal water for irrigating their fields which were high lands (Dal irrigation). The optimum lift from this method is 0.9 to 1.2 meters and the average discharge is 14000-19000 (litres/hr.).[1]

Dhekuli/Dhenkli is a human operated counterpoise lift consisting of a long wooden pole pivoted as a lever on a post with a weight fixed to the shorter end of the pole and a bucket to the long arm of the lever. A man stands next to the pit and pulls the rope down, and the bucket is drawn up by the counter weight. The daily discharge from a Dhekuli depends on the height of the water has to be lifted, the yield of the pit and the number of men taking turns to work it. The optimum lift from this method is 1.2 to 4 meters and the average discharge is 8000-11000 litres/hr.[2]

Rahat/Persian Wheel comes under medium lift devices. It consists of a chain and buckets mounted on an open spoked drum and provided with a suitable driving mechanism (for details see Michael pp.201-202). The operation of a 'Rahat' requires one pair of bullocks or he buffaloes or a single camal and one man. The optimum lift from a 'Rahat' is 5 to 10 meters and the average discharge is 14000 - 18000 litres/hr.[3] No doubt, 'Rahat' can lift water upto 10 meters but its efficiency is considerably reduced when the lift exceeds 7.5 meters.

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[1]A.M. Michael : Irrigation : Theory and Practice, Vikas Publishing House Pvt. Ltd., New Delhi, 1978, p.198.

[2]Ibid., p.198.

[3]Ibid., p.198.

In table 4.27 we present the details of area irrigated by traditional irrigation modes. In our sample villages total area irrigated by traditional modes was 238.77 acres. Out of it 218.72 acres was irrigated by the three devices we have explained in the preceding and 20.05 acres was irrigated by other traditional modes. In the table we have left out the area irrigated by other modes. In addition, we have taken 'Rahat' as a separate category but the other two modes have been clubbed together. This was done on account of three reasons. First, Rahat is a medium lift device while the other two are low lift devices. Second, the investment in case of Rahat is substantial as it involves a pair of bullocks, while the other two devices involve minimal investment as they are manually operated. Third, the irrigation capacity of a Rahat is much more in comparison to the other two devices.

The table clearly shows that in Deoria it is 'Dhekuli' or Dhekucha which is used while in Barabanki 'Rahat' is more popular among the traditional modes. The largest area irrigated by traditional modes is in Fatahabad (116 acres), followed by Kusmauni (43 acres). The average area irrigated per household is maximum in Fatahabad with 2.6 acres followed by Piparuli with 2.1 acres. In terms of average hours required to irrigate one acre, we notice that Rahat requires less than half the time required by other two modes for irrigating an acre. Our data shows that Dhekuli and Dhekucha require about 60 hours for irrigating an acre. However, in case of Misri Dhara it is about 67 hours per acre. The reason for more hours in case of Misri Dhara is that the land is considerably at a higher level in areas where Dhekucha is used. As a matter of fact in

Misri Dhara, there is no shortage of canal water but some patches of land are so high that farmers have to lift it from canal using Dhekucha method.

One reason why the indigenous modes, particularly the ones involving animal power, are waring out is because these involve a lot of capital investment but their irrigation efficiency is very low. Take for instance a 'Rahat' involving an investment which is about the same to one is required to make for a 5 hourse power pumpset. However, it take about 25 to 30 hours to irrigate one acre, while a 5 horse power pumpset will irrigate the same area in 5 to 6 hours. It is this uneconomical nature and low efficiency of the traditional modes which compels farmers to opt for PTW. It is for this reason that only about 6 per cent of total irrigated area in our sample was under traditional modes.

CHAPTER V

Summing Up

Indian economy is basically agriculture based, employing around 60 per cent work force and generating about 36 per cent of the National Income during 1981. Therefore, development of irrigation and better management of irrigation systems, both at macro and micro levels, are crucial to India's agricultural development. It goes without saying that irrigation has received high priority in our Five Year Plans. In 1950-51 when the economic planning began in India, the total irrigation potential in existence was 22.6 million hectares out of the total area of 132.8 million hectares under cultivation (17 per cent). The development of irrigation potential since 1951 till the end of Fifth Five Year Plan was 56.6 million hectares.[1] The Sixth Plan had originally envisaged creation of an additional potential of 13.74 million hectares, however the latest assessment was that the achievement might be only 11.5 million hectares. The total investment in irrigation under various plans upto March 1983 was estimated at Rs.18910 crores creating a total irrigation potential of 63.32 million hectares.[2]

The economy of Uttar Pradesh is far more agrarian than India's. In U.P. about 68 per cent of work force is engaged in agriculture and this sector alone generates about 51 per cent of the total income of the State. A natural corollary is the high

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[1] Shailaja Bapat : Irrigation in India : I - Potential and Use by Various States, Economic Times, January 25, 1984.

[2] Times of India (Lucknow Edition), December 12, 1983.

priority attached to the irrigation sector, particularly during the Plan era. During the pre-Plan period the total area irrigated by government schemes was about 2.7 million hectares. Out of this, 2.3 million hectares was irrigated through major, medium and minor schemes and about 0.4 million hectares by the State tubewells. The irrigated area under public irrigation schemes in U.P. has increased to about 5.85 million hectares upto 1979-80. Out of this 4.55 million hectares was irrigated by major, medium and minor schemes and 1.3 million hectares by State tubewells.[1] The Plan outlays of U.P. make it apparent that Sixth Plan lays major emphasis on irrigation. During Sixth Plan, it is proposed to invest Rs.1049.74 crores on major and medium schemes against the total expenditure of Rs.980.91 crores incurred upto 1979-80 under different Plans. In case of minor irrigation, an outlay of Rs.279.96 crores is proposed during the Sixth Plan against the total expenditure of Rs.442.49 crores upto 1979-80 under different Plans.[2]

Despite the high priority accorded and heavy investment made in the irrigation sector, the performance of schemes, particularly the major ones has been far from satisfactory. There are four facts linked with the performance of irrigation schemes in India, which are applicable to Uttar Pradesh also. First, the average yields of crops are still three to four times

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[1]Brief description of Work Progress, Irrigation Department, Investigation and Planning Circle, U.P., Lucknow, 1983-84, pp.21-22 (in Hindi)

[2]State-wise Irrigation Statistics, Government of India, Ministry of Irrigation (Minor Irrigation Division), New Delhi, March 1983, p.58.

lower than what can be achieved. Second, only those farmers who are located favourably in the canal system (head-reach) receive adequate and often more than adequate amount of water which they misuse at the expense of those who are located at disadvantageous points (tail-ends). Third, in many areas the long-term productivity of irrigated land is threatened by increased salinity, silting, water logging and flooding. As a matter of fact, two case studies of Gandak and Sarda Sahayak canal systems reveal that the introduction of intensive surface irrigation has given rise to water logging even at partial utilisation of canal potential for a short period. It is also evident that unless it is not pumped or drained out it would cause large scale water logging problem in the canal commands, making vast tract of cultivable land useless. It is, therefore, advisable that all such water development projects at the planning stage should take into account their effect on ground water regime of the area, and the feasibility of all the possible measures to negate the adverse effects to permissible limits and their influence on the economy of the project.[1] Fourth, the reliability of water delivery in terms of both timing and adequacy, is a major casuality in most of the large irrigation systems.

The Uttar Pradesh Government having felt the need for exploitation of immense major, medium and minor irrigation potential in the State appointed a seventeen member high power

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[1] Prakash Bahadur, B.N. Asthana and D.K. Gupta : Adverse Effects of Canal Irrigation - Issues, Measures and Approach, IE (I) Journal - C1, Vol.64, July 1983, pp.25-30.

commission in January 1983. It comprised of nine MLAs and the rest officials. The commission was headed by the leader of the opposition in the State Legislature (Mohan Singh), who was given the status of a Minister, and had as its members, the Engineer-in-Chief of Irrigation, the Secretaries of Irrigation and Finance, a representative of Geological Survey of India, and a retired Chief Engineer of Irrigation Department (Gauri Shankar Misra) as its technical adviser. The commission had a term of two years. It was to identify reasons for slow progress in exploiting major, medium and minor irrigation potential and was to suggest remedial measures and future policy projections.

However, according to a newspaper report appearing six months after the formation of the commission, the commission was having a trying time in tackling even the basic problems which were assigned to it. None of the files or relevant papers belonging to the previous Irrigation Commission could be found. The first commission was set up in 1966 but it lasted only a few months as it was abandoned under the economic drive. The second commission was set up in 1972 and it functioned for more than three years. Due to unknown reasons the findings of the commission were not published. As a result, the commission had to start its work from a scratch.[1]

The present study was undertaken with a view to examine the performance of the two main public irrigation systems - the

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[1]The Pioneer, a Lucknow daily, June 30, 1983.

large scale gravity irrigation systems and the State Tubewells. The performance of an irrigation system is the end product of so many interacting factors, the most important of which are, socio-economic, physical, technological and organisational. The process of water distribution in a public irrigation system is a function of the hydro-geographical condition in which the system is built, the physical layout of the distribution channels, the technological framework, the socio-economic scene of the area, and the management rules followed by the water authorities. These five elements interact and cannot be viewed as independent elements when systems are being operated. Therefore, the study attempts to examine the interaction of various elements which were possible for us to examine, keeping in view the time, resource and the data availability constraints.

The locale of the study were three districts of U.P. namely, Meerut, Barabanki and Deoria, representing three regions of the state, namely Western, Central and Eastern respectively. The study was confined to the Gangetic plain region of U.P. because it contains areas with most and least developed agricultural regions as well as a variety of irrigation systems. From the point of view of agriculture in general and irrigation in particular, Meerut is the most developed and Deoria is the least developed district of the Gangetic plains. In between, rather closer to Deoria is Barabanki. Three large scale canal systems commanding three districts namely, Gandak from Deoria, Sharda Sahayak from Barabanki and Upper Ganga from Meerut were selected. For the purposes of a detailed survey, three villages from each of the three districts were chosen. Two of the villages from

each district were from the head-reach and tail-end of the command of the canal project covering that district and the third village was commanded by the state tubewell. In all, 868 respondents from nine villages were interviewed during June-September 1981. The important findings the study are as follows :

In two of the three villages in Deoria district backward caste households constituted the largest number and in one it were the Rajputs. However, in terms of dominance of socio-economic and political spheres of village life, Rajputs dominated two villages and Backwards in one. In Barabanki, in all the three villages, backward castes (Kurmi and Yadav) were dominant numerically, economically and politically. In Meerut, one village each is dominated by Gujjars, scheduled castes and Jats. Generally high castes like Brahmins and Rajputs, even if they were minorities, enjoyed special/priviledged status either on account of large land holdings they possessed or their high position in village social hierarchy. Scheduled castes, on the other hand, even when they were majorities were least dominant with the exception of one village in Meerut. In a number of villages backward castes like, Yadavs, Kurmis, Gujjars and Jats were the dominant castes. All these caste people are tillers of the land in the exact sense of the term and being hard working have consolidated their limited resources and have become a force to reckon with, particularly in U.P. and Bihar. Taking sample villages as a whole, backward castes constituted the largest proportion of households (41 per cent), followed by 25 per cent scheduled castes, 15 per cent Gujjars and Jats, 11 per cent Rajputs and 5 per cent Brahmins. Backwards were

dominant castes in 4 villages, Rajputs in two and Gujjars, Jats and scheduled castes in one village each.

The examination of some important demographic characteristics in sample villages reveal that overall there are 54.4 per cent males compared to 45.6 per cent females. The average size of the household is 7.4, the highest being 9.1 for Pakri Babu while the lowest is 5.8 for Piprauli. The district-wise pattern indicates that Deoria has the largest average size while Barabanki has the lowest. The participation rate of the male population in the work force is 51 per cent for all the villages. Babakpur with 69 per cent has the highest male participation rate while Nagli Isa with 43 per cent has the lowest participation rate. The female participation rate in the work force is 32 per cent. Fatahabad with 38 per cent has the highest female participation rate while Babkpur with 11 per cent has the lowest. Generally female participate in a very high degree in Barabanki. The reason being preponderance of backward castes in the district, whose women folk unlike higher castes work in the fields. In terms of participation, Barabanki is at the top, followed by Meerut and then Deoria. The overall rate of literacy for the sample villages is 36 per cent. Pakri Babu with 49.5 per cent tops the list and Darapur with 23 per cent is at the bottom. The extent of self-employment in agriculture sector is highest in Meerut, followed by Barabanki and then Deoria.

An examination of the households in terms of land holding size reveal that as we move from west (Meerut) to east (Deoria), there is a rapid increase in the proportion of households with

marginal and small holding. The only exception in this respect is Pakri Babu, where Rajputs form a majority of the households. Further, in all the villages across the three districts high castes (Brahmins and Rajputs) have generally the largest land-holdings whether they constitute majority of the households or a handful of households in a village. Similarly the scheduled castes have the smallest holdings in all the villages. The district-wise pattern with respect to caste and the land holdings shows that Rajputs are the major land owning caste in Deoria. In Barabanki it is the Kurmis and Yadavs (backward) and in Meerut Gujjars and Jats have the largest share in the land. The average land holding per household is largest in Meerut with 4.5 acres, followed by Barabanki with 2.5 acres and then Deoria with 2.1 acres. With respect to leasing in, it is maximum in the small land holding size (1.1 to 2.5 acres). The average land leased in per household by this group is 0.9 acres and the average land owned by them is 1.5 acres. Thus, by leasing in land this group brings his cultivated land to a size which is not an uneconomic holding in relation to modern agriculture. The marginal households do not lease in land to a high degree because of a weak resource base and when they lease in it is just for survival.

The most appropriate combination of plough and bullock is one plough and two bullocks per household. However, this combination is prevalent only in two villages in Meerut namely, Babakpur and Modkalan. In rest of the villages, by and large, every household has one plough and one draught animal. The

average value of improved agricultural implements per household for the sample villages comes to Rs.3593, varying between Rs.603 in Misri Dhara and Rs.11999 in case of Modkalan (a difference of about twenty times). The district-wise pattern clearly demonstrates Meerut's pre-eminence in terms of average value of improved agricultural implements followed by Barabanki and then Deoria. With respect to the values of livestock and poultry also the district-wise pattern is similar. Our data also shows a positive relationship between the land holding categories and owning of improved agricultural implements. The general trend with respect to borrowing shows that Meerut in general and three canal head-reach villages in particular have a very high borrowing from institutional sources. This may be because in all head-reach villages, there is a relative abundance of irrigation water so farmers take loans for inputs and improved agricultural implements. In case of money lender, the highest proportion of households taking loan from this source are from Deoria.

The cropping intensity for sample villages is 161 per cent. It is highest in Misri Dhara with 201 per cent and lowest in Modkalan with 139 per cent. District-wise cropping intensity is highest in Deoria followed by Barabanki and then Meerut. The low intensity in Meerut is on account of extensive sugarcane cultivation. Looking at the data in terms of gross irrigated area as proportion of gross cropped area, we find that the first three and the next three positions are held by canal head-reach and canal tail-end villages respectively from the three districts, while the last three villages are the ones with state tubewell

irrigation. This means that canal as a source of irrigation is much more dependable than state tubewell.

In all villages 42 per cent of gross cropped area consists of kharif crop, 51 per cent of rabi crop and 7 per cent of zaid (summer) crop. Zaid crop is grown mainly in Meerut and in one of the villages it consists of 22 per cent of gross cropped area. The analysis of cropping pattern shows that wheat is the most important crop in all the villages except two villages of Meerut where sugarcane is the most important crop. Paddy is the most important crop of six villages of Barabanki and Deoria districts. Sugarcane is the third most important crop. The other important crops in the sample villages are pulses, potato and gram in order of importance.

In chapter II we talked about sample villages in terms of their socio-economic pattern, demographic characteristics, land use pattern, ownership of agricultural implements, pattern of borrowing and cropping and cropping pattern. In chapter III, we have discussed the same aspects relating to agriculture in relation to irrigation systems as evolved by us.

The examination of source-wise areas irrigated in sample villages reveal that canal is the predominant source of irrigation as far as head-reach villages are concerned. It is also the most important source of irrigation with the combination of PTW in all the tail-end villages. PTW is found to be the most important source of irrigation in state tubewell villages rather than STW itself. It is clear indication of the very poor performance of the STW. Finally it can be said that between the two public irrigation systems, canal fares far better

than state tubewell. In terms of importance, canal is the most important system irrigating 47 per cent of gross irrigated area followed by PTW (43 per cent), TRD (6 per cent) and STW (4 per cent).

Distribution of households by land holding categories in different irrigation systems indicates that in case of small and marginal farmers canal is the most important source of irrigation followed by its combination with either PTW or TRD. Contrary to this in case of medium and large farmers the combination of CNL and PTW is found to be the most important source of irrigation followed by CNL alone. As regard the two private irrigation systems, the traditional system is used by the largest proportion of marginal households, while PTW is more in vogue among the households belonging to small or the higher landholding categories.

Relationship between improved agricultural implements and various irrigation systems shows that the least resourceful households, in terms of owning of improved agricultural implements, are the ones who are using TRD alone or in combination with other sources. None of the households using PTW and TRD own either a pumpset or a tubewell and all of them are hiring these to supplement TRD irrigation. The most resourceful households are those who are using PTW or PTW + CNL. To own a tubewell is to own a resource and it eliminates the risk element in agriculture, particularly, in the areas where canal water is also available. This also means owning more improved agricultural implements for a profitable agriculture.

Therefore, it is quite logical that farmers under PTW and PTW + CNL are most resourceful.

Some important economic characteristics related to cultivation in different irrigation systems are also analysed. The net cropped area per household is highest in the category of 'others' as it includes farmers which have the largest land-holdings. It is followed by PTW + CNL because most of the farmers falling under this category own a tubewell/pumpset to irrigate their big land holdings. The lowest net cropped area per household is with those who are using TRD or TRD + CNL as most of them are small and marginal farmers. The cropping intensity is highest among CNL households followed by CNL + TRD because small and marginal farmers make more intensive use of their meagre land.

In the three irrigation systems, Gandak, Sharda Sahayak and Upper Ganga, mode of sharing canal water in head-reach and tail-end villages is also discussed. It is found that "osrabandi" is very much successful in Upper Ganga, to some extent successful in Sharda Sahayak and is not used at all in Gandak system. The reason behind it is that Upper Ganga is a very old system and osrabandi was started right after its introduction and has got stabilised and institutionalised over the last one century. In case of Sharda Sahayak system, it is not that old but is old enough to give credence to "osrabandi" system. In case of Gandak, the system is very new and the system of "osrabandi" has yet to take roots. The other forms of distribution of water among users are, "mutual understanding in water

distribution", and "might is right". The last one is commonly used in Gandak and the tail-end village of Sharda Sahayak system. The same phenomenon of mode of sharing state tubewell water is also examined. "Might is right" is the most prevalent modus operandi in water distribution in all STW villages due to uncertainty of electric supply. This means that stronger always take water and weak and poor - marginal and small farmers remain non-recipients.

The examination of conflict resolution mechanism reveals that where water is available in sufficient quantity conflicts do not occur and where the water is not available as per requirement conflicts do occur. The most common method of conflict resolution is "mutual reconciliation with or without the third party". It is resorted to in Meerut and Deoria. Help of Village Pradhan is often taken in Deoria and some times in Barabanki but he is never approached in Meerut. In Barabanki "might is right" appears the order of the day. The same phenomenon of conflict resolution in the context of STW irrigation has also been examined. In case of STW also, "mutual reconciliation with or without third party" is the most commonly used mode in all the three villages, followed by "might is right". With respect to utilisation of the services of the Village Pradhan, the pattern is similar to what we find in case of canal. Here also his services are utilised in Barabanki and Deoria. To explain it, we have to understand that Meerut is the most advanced district and Deoria is most backward district in our sample. It is a commonly accepted premise that in backward area the traditional

leaders perform all kinds of functional requirements which is not so in advanced areas. This is substantiated by our sample.

The extent of hiring of punp sets and tubewells is also discussed at some length by us. A distinct feature emerging from the examination is that a very large proportion of households own PTW/PS in STW villages, particularly, in Meerut and Barabanki. In Deoria although significant proportion of households own PTW/PS but not large enough to compare with STW villages in other two districts. However, Deoria STW village tops in hiring in of PS/PTW, which means that lot of area is irrigated by these implements in the village. The main reason behind smaller number of PTW/PS in Deoria village is that only Rajputs can afford it economically, having the largest land holdings. But others also need it so they hire it from the Rajputs. This again confirms that STW is the most hopeless system of public irrigation. Looking at the distribution of households owning pumpsets and tubewells by land holding and source of finance, it is apparent that very small farmers do not own either a tubewell or a pumpset. Many middle range farmers own these but more often than not buy it with their own finances and the big farmers obtain bank loans for their purchase. Very big farmers again buy these implements with their own finances.

In chapter IV we have talked about the performance of irrigation systems. The irrigation systems taken by us can be grouped in two categories - public and private. In case of public irrigation systems, we have taken canals and STW and canals have been further divided into two categories; head-reach and tail-end. In case of private irrigation systems, we have taken PTW and TRD.

Thus, we have taken four types irrigation systems. However, not all the households take irrigation by a single source hence, we have taken the combinations of twos in addition to four types. Thus in all, we have studied ten types of irrigation systems. Performance of these systems has been examined in terms of interaction of irrigation technology, agricultural technology and social factors. The other angle from which it has been examined is users' experiences, opinions and evaluations of systems as well as the officials. The findings thus arrived at are as follows.

In the production of wheat and sugarcne the combination CNL + PTW show the best results. Households using this combination of irrigation crop the largest proportion of area and obtain the maximum yield. In case of wheat the yield is 9.3 qntls/acre by using 13.3 kg/acre HYV seeds and 81.3 kg/acre fertilizers. In case of sugarcane the yield is 202.5 qntls/acre which is obtained by using 116.5 kg/acre HYV seeds and 130 kg/acre fertilizers. In case of paddy the highest productivity of 9.2 qntls/acre is under CNL where the use of HYV seeds is 1.5 kg/acre and that of fertilizers 69.9 kg/acre. As a matter of fact, the households under this category use very small amount of HYV seeds and other seeds. Even the total seeds are below the overall average. It is to be noted that in case of all the crops local and local improved seeds are also used in addition to HYV seeds. Our study clearly indicates the superiority of canal irrigation in comparison to other single systems. However, the combination of CNL + PTW turns out to be the best. As a matter of fact, PTW combines very well with any

single system of irrigation leading to the conclusion that PTW is the best system when it comes to making use of more than one source for irrigation.

With respect to adequacy and regularity of canal water delivery, head-reach villages have much better supply than tail-end ones. Further, the level of adequacy and regularity is better in kharif and rabi compared to zaid. Generally Gandak system is best in terms of adequacy and regularity followed by Sharda Sahayak and then Upper Ganga. However, with respect to zaid Upper Ganga turns out to be the best. The most often mentioned reason for the inadequate and/or irregular water delivery in all canal villages is short supply in the outlet, mentioned by 37 per cent head and 34 per cent tail villages. There are two second most often mentioned reasons both containing 22 per cent of responses. These are "hindrances by upper reach farmers" and "distant locations of the field at the end of the outlet". The third most often mentioned reason, particularly in the tail villages, is bad maintenance of canal structres. In case of STW the adequacy and the regularity scores are generally poor and are poorest in Pakri Babu. The scores are highest in kharif followed by rabi and are very poor in zaid. Comparison of canals and STWs clearly brings out that STW delivery of water is far more inadequate and irregular compared to canal. The most often mentioned reason for this state of affairs in case of STW is irregular and rare supply of electricity mentioned by 53 per cent of users. 25 per cent of users mention that the STW is out of order most of the time, and 12 per cent mention the ill-maintenance of irrigation channels.

As regard the correctness of water rates, 42 per cent users report that water rates are generally incorrect or sometimes incorrect. The percentages for head-reach villages being 36 and for tail-end ones 49. The overall impression we gather is that Sharda Sahayak is best in this count, followed by Gandak and then Upper Ganga. Compared to canals the opinion of users is more negative in case of STW. With respect to reasons for the incorrect assessment the two most often mentioned ones, both in case of canal and STW are : (i) assessment without field visit mentioned by 77 per cent in canals and 87 per cent in STW; (ii) officials expect bribe, mentioned by 19 per cent canal and 13 per cent STW users. Lesser percentage with respect to the second reason in case of STW is because there are other avenues of money making by officials in the latter.

We asked a series of questions from the water users concerning the kind of problem they faced in the delivery of water, whom did they approach to rectify the problem and what was the outcome of the problem? A large proportion of users said, they did not face any problem, the overall percentage for the canal users being 62 which in case of head users was 72 and in case of tail 46. Gandak head users faced lest problems, followed by Sharda Sahayak and then Upper Ganga. In case of tail users, Sharda Sahayak faced least problems, followed by Upper Ganga and then Gandak. The most urgent problem concerning the delivery of water in all canal villages was, "inadequate and irregular supply of water", followed by "break down in canal structures", and then "breaking of structures and illegal diversion of water by users". In case of STW there was no village where users had no

problems. The biggest problem was "irregular and inadequate supply of electricity", followed by "STW out of order most of the time" and then "command of STW being too big to cope with the requirement of the users".

With respect to the second question, 62 per cent canal users said they never approached any one. But the interesting part of it was; of those who approached officials for the rectification of the problem 95 per cent reported that no help was rendered to them by the officials. 4 per cent mentioned that the officials did make efforts but the problem remain unsolved and only in 1 per cent cases the problem was solved with the official efforts. In case of STW 68 per cent users never approached officials. Of those approached none got any help although in one case in Modkalan and in 3 cases in Pakri Babu officials did make efforts but no success was obtained. As a matter of fact, the data in tables 4.12 to 4.15 speak volume about the job performance of the officials and no significant differences are observed in head or tail, canal or STW and CAD covered or non CAD covered areas.

As regard the knowledge of the offices of various concerned canal and STW officials, there are variations in head and tail villages and generally a greater proportion of tail-enders know of the offices of the official compared to head reach farmers. However, no such variation exists in case of Upper Ganga. Further, more users know the offices of Executive Engineer and Assistant Engineer than that of Overseer and Ziladar and least know about Deputy Revenue Officer. All this indicate that it is the tail-enders who face the problems on maximum number of occasions and

when it so happens they approach the Executive Engineer on the Assistant Engineer and hence know their offices. In case of Upper Ganga, the system is so old that users know all the concerned offices, whether users are in head or in tail and hence no differences in their knowledge. In addition, there is more strict "warabandi" in Upper Ganga because of which problems, particularly those relating to shortages of water, are faced equally by head and tail farmers. As regard the CADA staff in Gandak and Sharda Sahayak, head tail differences in the knowledge of office do exist but unlike canal staff here more head users know CADA staff than tail users, which may imply that more CADA work is being done in head reaches, where relatively more water is available than tail reaches where water is a scarce commodity.

In case of evaluation of the staff by the water users, we have confined it to those staff who have the maximum interaction with the water users, hence in case of canal and STW staff, Amin and Patrol and in case of CADA, Soil Conservation Inspector (SCI) and Assistant Soil Conservation Inspector (ASCI) were chosen for the evaluation. With respect to canal, a greater proportion of head-reach users mentioned the work of Amin and Patrol as good compared to tail-enders in all three systems. In case of CADA, majority of the users said, they did not know about the work of CADA staff, hence did not evaluate. However, little information we could collect about the work of SCI and ASCI clearly indicate differences between the two CADA covered systems the first position in terms of good work by CADA staff was obtained by Misri Dhara, followed

by Kusmauni (both Gandak). In case of Piprauli all those who evaluated CADA staff said, they did a bad work while in case of Fatahabad no one had any idea about what CADA staff did. This implies two things, that, we have already mentioned that CADA work is being done in advantageous positions (in terms of water delivery) and as the work is completed no attention is paid in later stages. This is obvious because in Barabanki the CADA work was done about five years back and at that time "Kulaba Samitis" were also formed but after sometime no follow up took place, therefore, users either do not know about CADA staff's work or evaluate their work as bad.

The respondents were also asked to suggest the remedial measures so that deliveries of water in canals as well as in STW could be improved. In case of canal 60 per cent of the users mentioned that they did not have any idea. Those who suggested said that, (i) there should be provision of field channels; (ii) sincere work attitude among officials; (iii) proper controlstructures; (iv) closer proximity between outlet commands and outlet capacities; (v) proper maintenance of canal structures; (vi) rigourous implementation of osrabandi; and (vii) alter tions in canal structures wherever they were necessary. With respect to STW, a smaller proportion (44 per cent) said they had no idea. Those who suggested, their responses in terms of ranking are as follows : (i) repair and proper maintenance of irrigation channels; (ii) more regular supply of electricity; and (iii) sincerety to work among the staff.

The question, who gets what and how is also relevant in the context of irrigation, particularly public irrigation systems. Several earlier students of irrigation have examined this question and majority of them find that bigger and richer farmers are greater beneficiaries of canal water. We have examined this question in relation to land holding size and caste. Our data shows that there is a positive relationship between the size of land holding and the area irrigated by public irrigation systems. Our data clearly demonstrates that benefits of public irrigation systems are skewed in favour of bigger land owning classes and higher castes.

Thus far we have been talking of our findings concerning the public irrigation systems, i.e. canal and state tubewell. We have also studied the two private irrigation systems - private tubewells and traditional modes of irrigation. With respect of PTW we find, they are minimal in head-reach villages and maximum in STW villages in each district. District-wise, Meerut with 21.4 per cent of households with PTW tops the list, closely followed by Barabanki with 20.5 per cent and Deoria with only 6.3 per cent of households is at the bottom. The average number of households irrigating their land per tubewell is very high in all tail-end villages. This means that critical shortage of water in such villages is supplemented by PTW irrigation. However, in terms of per tubewell irrigated area, it is found that its maximum utilisation is taking place in STW villages. This reinforces our earlier finding that as a source of irrigation STW fares very badly and farmers have to go in for PTW irrigation in such villages. In head-reach villages, PTW

is being utilised to a minimal degree. The district-wise pattern indicates that its best utilisation is taking place in Deoria, followed by Meerut and then Barabanki.

In terms of cost effectiveness, which we have calculated on the basis of running cost per year, our data clearly show an inverse relationship between the size of land holding and per acre running cost. In case of marginal households the annual running cost per acre comes to Rs.237 but it goes down to Rs.112 in case of large households. With respect to difficulties faced in the running of PTW by the users, the largest proportion (53 per cent) report that rare and/or irregular supply of electricity is their main difficulty. 36 per cent mention scarce availability of diesel or its availability at distant places is their main worry. However, there are 11 per cent users who report that they do not face any problem.

In our sample villages a total of 23877 acres of area was irrigated by traditional devices, out of this 218.72 acr was irrigated by three devices namely Rahat, Dhekuli and Dhekcha. In terms of average hours required to irrigate one acre, we found that Rahat required less than half the time required by other two modes. Even Rahat required 25 to 30 hours for irrigating one acre, which is four to five times more than a five horse power PTW requires. Rahat is no more a cost effective mode of irrigation as it requires good amount of capital investment and is at the sametime a very inefficient mode of irrigation. It is for this reason, farmers have been switching over to PTW and it is for this reason, only 6 per cent of gross irrigated area is irrigated by traditional modes of irrigation in our sample villages.

One of the objectives of the study was to examine the performance of irrigation systems in terms of their organisation. With respect to this end, we had hoped to study the bureaucratic organisations as well as irrigation farmers' organisations. In terms of bureaucratic organisations we did not find any significant difference in the CADA and non CADA irrigation projects. The other aspects, which we had hoped to study and which would have brought out interesting comparisons is irrigation farmers' organisations. To our dismay, neither in Sharda Sahayak nor in Gandak we found any farmers committees/organisations worth the name. Henry Hart who had visited seven command areas in India during July-August 1978 was highly impressed by the performance of "Kulaba Samitis" (outlet committees) in Barabanki district under Sharda Sahayak Command.[1] However, our visits in the Fatehpur Tehsil of Barabanki district during June 1980 disclosed us that "Kulaba Samitis" existed on paper alone. The picture was no different during our visits to the sample villages in Gandak and Sharda Sahayak during June-September 1981 and our visits to the Sharda Sahayak sample villages during October 1982. On paper, farmers are involved and consulted but in reality they are never associated, particularly in micro designing of OFD works. As a ritual "Kulaba Samitis" are formed when CADA is engaged in OFD planning and construction but the committees disolve the moment construction work is over.

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[1] For detail see, Henry Hart : Anarchy, Paternalism, or Collective Responsibility Under the Canals? Economic and Political Weekly, Review of Agriculture, December 1978, pp.A131-133.

At the closing, we would like to advocate once again, what we have been emphasising again and again elsewhere[1] that farmers organisations are a must at the water-course level in large scale gravity irrigation systems in India. The utility of such organisations is evidenced in the findings of the scholars all over the world. However, despite various government pronouncements about the necessity of farmers organisations and their existence on paper, we did not come across a single effective Kulaba Samiti in the two CAD covered projects in the districts of Barabanki and Deoria.

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[1] Following works of the author have direct relevance in this respect.

(i) Niranjan Pant : Utilisation of Canal Water below Outlet in Kosi Irrigation Project : Administrative and Community Level Solutions, Economic and Political Weekly, Vol.XVI, No.39, Review of Agriculture, September 1981; (ii) Niranjan Pant and R.K. Verma, Farmers Organisations and Irrigation Management, Ashish Publishing House, New Delhi, 1983; (iii) Niranjan Pant, Farmers' Organisations in Large Irrigation Projects in India, paper presented at "National Seminar on Policies for Irrigated Agriculture", Administrative Staff College of India, Hyderabad, February 20-22, 1984.

Table 1.1 : Total Number of Cultivators and Agricultural Labour in India

Work Categories	Total Workers	
	1971	1981
1. Cultivators	78.3 (43.4)	91.4 (37.0)
2. Agricultural Labourers	47.5 (26.3)	55.4 (22.4)
3. Others	54.7 (30.3)	100.3* (40.6)
Total	180.5 (100.0)	247.1 (100.0)

Source : Indian Agriculture in Brief, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi, 1982, p.2.

* Includes marginal workers.

Note : Figures in parentheses indicate percentage.

Table 1.2 : National Income According to Major Heads at Current and 1970-71 Prices

Major Heads	1971	1981	
	At current prices	At curre- nt prices	At 1971 prices
1. Agriculture	16354 (47.8)	37909 (36.4)	18902 (40.0)
2. Forestry/Logging	397 (1.2)	1335 (1.3)	408 (0.9)
3. Fishing	229 (0.7)	762 (0.7)	289 (0.6)
4. Mining and Quarrying	327 (0.01)	1473 (1.4)	466 (1.0)
5. Manufacturing, Construction, Electricity, gas and water supply	6790 (13.8)	24421 (23.4)	10035 (21.3)
6. Transport, Communications and Trade	5454 (15.9)	21580 (20.7)	8684 (18.4)
7. Finance and real estate	1683 (4.7)	5618 (5.4)	2708 (5.7)
8. Community and personal services	3285 (9.6)	11034 (10.6)	5701 (12.1)
9. Net factor income from abroad	-284	69 (0.1)	18 (0.04)
10. Total Net National Product	32235 (100)	104201 (100)	47211 (100)
11. Per Capita Income	632.8	1536.9	696.3

Source : Indian Agriculture in Brief, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi, 1982, pp.4-5.

Table 1.3 : Plan-wise Investment on Irrigation

(Rs. in crores)

Plan Periods	Major & Medium	Minor			Total
		Plan Outlays	Institu- tional	Total	
First Plan (1951-52 to 1955-56)	380	76	Neg.	76	456
Second Plan (1956-57 to 1960-61)	380	142	19	161	541
Third Plan (1961-62 to 1965-66)	581	328	115	443	1024
Annual Plan (1966-69)	434	326	237	563	997
Fourth Plan (1969-74)	1237	513	661	1174	2411
Fifth Plan (1974-78)	2442	631	780	1411	3853
Total	5454 (58.8)	2016 (21.7)	1812 (19.5)	3828 (41.2)	9282 (100.0)
Sixth Plan	6702 (65.0)	1415 (13.7)	2200 (21.3)	3615 (35.0)	10317 (100.0)
Likely during 1978-79	976	237	270	507	1483
Approved for 1979-80	1096	222	375	597	1693

Source : Irrigation Development in India - Tasks for Future, Indian Agricultural Research Institute, New Delhi, February, 1980.

Note : Figures in parentheses indicate percentage.

Table 1.4 : Plan-wise Irrigation Potential

(in million ha.)

Plan Period	Major & Medium	Minor Irrigation			Total Irrigation
		Ground	Surface	Total	
Pre-Plan (1950-51)	9.70	6.50	6.40	12.90	22.60
End of First Plan (1955-56)	12.19	7.63	6.43	14.06	26.25
End of Second Plan (1960-61)	14.33	8.30	6.45	14.75	29.08
End of Third Plan (1965-66)	16.56	10.52	6.48	17.00	33.56
End of Annual Plan (1968-69)	18.10	12.50	6.50	19.00	37.10
End of Fourth Plan (1973-74)	20.70	16.50	7.00	23.50	44.20
End of Fifth Plan (1977-78)	24.77 (47.60)	19.80 (38.00)	7.50 (14.40)	27.30 (52.40)	52.07 (100.00)
Annual Plan (1978-80)	2.30	NA	NA	1.50	3.80
Total	27.07 (48.45)	NA	NA	28.80 (51.55)	55.87 (100.0)
Target (Sixth Plan)	6.50	7.00	1.50	8.50	15.00
Ultimate Feasible	58.50	40.00	15.00	55.00	113.50

Source : Irrigation Development in India - Tasks for Future, Indian Agricultural Research Institute, New Delhi, February, 1980.

Note : Figures in parentheses indicate percentage.

Table 1.5 : Number of Cultivators and Agricultural Labours in Uttar Pradesh

(in '000)

Work Categories	Total Workers	
	1971	1981
1. Cultivator	15698 (57.4)	18740 (53.1)
2. Agriculture Labour	5454 (20.0)	5273 (15.0)
3. Others	6183 (22.6)	11255* (31.9)
Total	27335 (100.0)	35268 (100.0)

* Includes marginal workers also.

Source for 1971 : Census of India, 1971, U.P., Part II-A, General Population Tables, pp.294-295.

Source for 1981 : Indian Agriculture in Brief, Directorate of Economics and Statistics, Department of Agriculture and Statistics and Cooperation, 1982, p.179.

Note : Figures in parentheses indicate percentage.

Table 1.6 : Sector-wise Total Income of Uttar Pradesh During 1979-80

(Rs. in crores)

Sector	1979-80
1. Agriculture and allied	5654 (51.4)
2. Manufacturing	1166 (10.6)
3. Others	4180 (38.0)
Total	11000 (100.0)
State per capita income (Rs.)	1070

Source : Draft Sixth Five Year Plan, 1980-85, Vol.1 (Review), Government of Uttar Pradesh, Planning Department, p.90.

Table 1.7 : Financial Outlays for Irrigation in Uttar Pradesh

(Rs. in crores)

Plan Periods	Major and Medium Irrigation	Minor Irrigation	Total	Institutional Investment for Minor Irrigation
Upto 1979-80	980.91	442.49	1423.40	345.82
VI Plan proposed	1049.74	279.96	1329.70	283.00
During 1980-81	186.58	51.49	238.06	53.48
During 1981-82	178.00	52.71	230.71	43.20
Likely 1982-83	179.80	52.54	232.34	43.00
Apprd. 1983-84	206.00 (Tentative)	64.02	270.02	45.49

Source : State-wise Irrigation Statistics, Government of India, Ministry of Irrigation (Minor Irrigation Division), New Delhi, March 1983, p.58.

Table 1.8 : Plan-wise Area Irrigated Through Different Sources in Uttar Pradesh

(area in lakh ha.)

	Area irrigated by major, medium and minor irrigation (ex. STW)	Area Irrigated by STW	Total	No. of STW (working)	STW energised
Pre Plan	23.00	3.85	26.85	2305	NA
Upto end of First Plan	24.83	4.57	29.4	4260	NA
Upto end of Second Plan	28.32	8.25	36.57	6668	NA
Upto end of Third Plan	31.75	11.84	43.59	8235	NA
Upto end of Fourth Plan	35.22	13.00	48.22	12447	12838
Upto end of Fifth Plan	43.03	13.00	56.03	14560	13522
Upto end of 1979-80	45.53	13.00	58.53	16622	17884
Upto end of 1983-84 (Estimated)	46.99	8.03	55.02	21016	22363

Source : Brief Description of Work progress, Irrigation Department, Investigation and Planning Circle, U.P., Lucknow, 1983-84, pp.21-22, (in Hindi).

Table 1.9 : Details of Irrigation Potential Created/Utilized in Uttar Pradesh

('000 Ha.)

	Major & Medium		Minor Irrigation (Utl.)			Total Irrigation	
	Pot.	Utl.	Ground Water	Surface Water	Total	Pot.	Utl.
Ultimate	12500	-	12000	1200	13200	25700	25700
Pre-Plan	2553	2533	2300	600	2900	5453	5433
Upto 1979-80	6029	4941	8130	710	8840	14869	13781
VI Plan (T)	1200	1359	3320	30	3350	4550	4709
Actual (1980-81)	252	71	750	5	755	1007	826
Actual (1981-82)	281	595	634	23	717	998	1312
Likely (1982-83)	135	141	639	20	659	794	800
Target (1983-84)	55	233	600	6	606	661	839

Source : State-wise Irrigation Statistics, Government of India, Ministry of Irrigation (Minor Irrigation Division), New Delhi, March 1983, p.58.

Table 1.10 : Demographic Profile of the Three Districts as Per 1981 Census

	Meerut	Barabanki	Deoria	U.P. State
Per cent share in population	2.50	1.80	3.15	100.00
Per cent share in area	1.32	1.50	1.80	100.00
Density of Population (per sq. km.)	708	453	642	377
Agri. workers as % to total workers	55.72	86.55	83.87	74.55
Per cent share of urban population	31.22	8.92	6.63	17.95
Literacy rate	34.68	18.87	23.20	27.16
Female per thousand of male population	838	859	988	885

Source : District-wise Indicators of Development, Area Planning Division, State Planning Institute, U.P., August 1983.

Table 1.11 : Land Use Statistics in the Three Districts-1980-81

	Meerut	Barabanki	Deoria	U.P. State
Net sown area as per cent to total area	79.45	65.16	82.61	57.91
Cropping intensity	161.41	153.71	146.87	142.69
Size of holding in hect. (1976-77)	1.39	0.82	0.76	1.18
Net sown area per cultivator in hect.	1.10	0.60	0.70	0.92
Per cent of gross sown area irrigated	87.57	42.79	48.21	46.33
Fertilizer consumption kg./hect. (1981-82)	106.81	51.84	72.49	51.66

Source : District-wise Indicators of Development, Area Planning Division, State Planning Institute, U.P., August 1983.

Table 1.12 : Percentage Distribution of Area Source-wise 1980-81

	Meerut	Barabanki	Deoria	U.P. State
Canal	32.96	59.54	41.15	33.62
Tube-well	65.71	31.62	47.18	53.45
Other well	0.92	4.21	3.23	7.90
Tank, pond, etc.	0.01	3.64	2.31	1.76
Others	0.39	1.00	6.13	3.27
Total	100.00	100.00	100.00	100.00

Source : Directorate of Agriculture (Statistics), U.P., Publication No.72, Agricultural Statistics of U.P. 1980-81, pp.16-19. (in Hindi).

Table 1.13 : Some Elements of Modernisation

	Meerut	Barabanki	Deoria	U.P. State
No. of tractors per '000 hect. of sown area (80-81)	15.11	N.A.	3.48	2.57
No. of energised pumpsets per '000 hect. of sown area (82-83)	68.06	10.58	10.51	17.57
Percentage of electrified villages	65.47	32.18	34.98	45.53
Per capita consumption of electricity in kwh (79-80)	130	30	30	90
Gross value of agri. produce per hect. of net sown area in 1978-79	4676	3449	3262	2919
Per capita net domestic product (78-79)	710	615	454	598

Source : District-wise Indicators of Development, Area Planning Division, State Planning Institute, U.P., August 1983.

Table 1.14 : Area and Productivity of Some Major Crops

	Meerut	Barabanki	Deoria	U.P. State
As percentage to total cropped area				
a. Paddy	4.19	34.12	36.75	21.52
b. Wheat	33.47	35.03	35.91	33.01
c. Sugarcane	28.84	2.70	10.56	5.55
Productivity in qtl./hect.				
a. Paddy	13.81	11.40	11.00	10.53
b. Wheat	22.89	14.91	16.63	16.50
c. Sugarcane	541.42	363.72	423.64	470.90

Source : Agricultural Statistics of U.P., 1980-81, Director (Agricultural Statistics), Directorate of Agriculture, U.P. (in Hindi).

Table 2.1 : Distribution of Households by Religion and Caste Groups in Sample Villages.

District/ Village	Religion and Caste Groups							Total
	Brahmin	Rajput, Bhumihar	Jat, Gujjar	Yadav, Koiri, Kurmi	Other Backward castes	Scheduled Castes	Muslims	
Deoria								
Misridhara	4 (3.7)	15 (13.9)	- -	42 (38.9)	29 (26.8)	18 (16.7)	- -	108 (100.0)
Kusmauni	7 (7.0)	6 (6.0)	- -	43 (43.0)	32 (32.0)	9 (9.0)	3 (3.0)	100 (100.0)
Pakri Babu	- -	40 (43.5)	- -	29 (31.5)	12 (13.0)	10 (10.9)	1 (1.1)	92 (100.0)
Barabanki								
Piprauli	1 (1.0)	- -	- -	52 (51.5)	1 (1.0)	46 (45.5)	1 (1.0)	101 (100.0)
Fatehabad	- -	1 (1.2)	- -	29 (34.5)	- -	53 (63.1)	1 (1.2)	84 (100.0)
Darapur	5 (5.1)	7 (7.1)	- -	67 (68.4)	8 (8.2)	11 (11.2)	- -	98 (100.0)
Meerut								
Babakpur	19 (18.1)	- -	74 (65.5)	- -	6 (5.7)	2 (1.9)	4 (3.8)	105 (100.0)
Nagli Isa	5 (5.6)	27 (30.0)	- -	- -	4 (4.4)	54 (60.0)	- -	90 (100.0)
Mod Kalan	5 (5.6)	- -	64 (71.1)	- -	4 (4.4)	17 (18.9)	- -	90 (100.0)
Total	46 (5.3)	96 (11.1)	138 (15.9)	262 (30.2)	96 (11.1)	220 (25.3)	10 (1.1)	868 (100.0)

Note : Figures in parentheses indicate percentages.

Table 2.2 : Some Important Demographic Characteristics of Sample Villages

District/ Village	No. of House-holds	No. of Persons			Ave. Size of H.H.	Participation Rate			Literacy Rate
		M	F	Total		M	F	Total	
Deoria									
Misridhara	108	445	417	862	8.0	48.3	26.1	37.6	29.3
Kusmauni	100	429	385	814	8.1	47.5	12.2	30.8	32.0
Pakri Babu	92	476	366	842	9.1	48.1	18.8	35.4	49.5
Barabanki									
Piprauli	101	320	266	586	5.8	57.2	27.4	43.7	32.2
Fathabad	84	295	235	530	6.3	50.2	37.9	44.7	28.1
Darapur	98	393	341	734	7.5	52.4	28.1	41.1	23.3
Meerut									
Babakpur	105	356	334	690	6.6	69.1	11.4	41.1	49.1
Nagli Isa	90	391	287	678	7.5	43.0	23.3	34.7	35.7
Mod Kalan	90	392	299	691	7.7	51.0	19.1	37.2	38.1
Total	868	3497	2930	6427	7.4	51.4	22.0	38.0	35.5

Table 2.3 : Per Cent Distribution of Workers by Occupation in Sample Villages

District/ Village	Percentage of Workers			Total
	Agr.	Agr.Lab.	Others	
Deoria				
Misridhara	49.4	12.6	37.0	100.0
Kusmauni	59.4	8.3	32.3	100.0
Pakri Babu	53.7	-	46.3	100.0
Barabanki				
Piprauli	69.1	9.4	21.5	100.0
Fatehabad	57.4	10.1	32.5	100.0
Darapur	64.3	3.6	32.1	100.0
Meerut				
Babakpur	76.8	0.7	22.5	100.0
Nagli Isa	65.9	19.6	14.5	100.0
Mod Kalan	83.7	11.3	5.0	100.0
Total	64.0	8.1	27.9	100.0

Table 2.4 : Distribution of Households by Land-holdings in Sample Villages.

District/ Village	Landholding Categories (in acres)					Total	Average Landholding per house holds (acres)
	Less than 1.0	Small 1.1-2.5	Medium 2.6-5.0	Large 5.1-10.0	Large More than 10.0		
Deoria							
Misridhara	45 (41.7)	48 (44.4)	6 (5.6)	7 (6.5)	2 (1.8)	108 (100.0)	1.541
Kusmauni	30 (30.0)	63 (63.0)	7 (7.0)	- -	- -	100 (100.0)	1.50
Pakari Babu	7 (7.6)	46 (50.0)	23 (25.0)	12 (13.0)	4 (4.4)	92 (100.0)	3.60
Barabanki							
Piprauli	28 (27.7)	41 (40.6)	15 (14.8)	13 (12.9)	4 (4.0)	101 (100.0)	2.76
Fatehabad	15 (17.9)	46 (54.8)	17 (20.2)	5 (5.9)	1 (1.2)	84 (100.0)	2.36
Darapur	10 (10.2)	51 (52.0)	29 (29.6)	6 (6.1)	2 (2.1)	98 (100.0)	2.83
Meerut							
Babakpur	10 (9.5)	28 (26.7)	40 (38.1)	25 (23.8)	2 (1.9)	105 (100.0)	4.21
Nagli Isa	7 (7.8)	38 (42.2)	19 (21.1)	20 (22.2)	6 (6.7)	90 (100.0)	3.96
Mod Kalan	15 (16.7)	5 (5.6)	24 (26.6)	36 (40.0)	10 (11.1)	90 (100.0)	5.72
Total	167 (19.2)	366 (42.2)	180 (20.7)	124 (14.3)	31 (3.6)	868 (100.0)	3.26

Note : Figures in parenthesis indicate percentages.

Table 2.5 : Details About Leasing Activities in Sample Villages

(Land in acres)

District/ Village	No. of hhs.	Av.land owned per hh.	No.of hh. Leasing in	Av.area leased in per hh.	No.of hh. Leasing out	Av.area leased out per hh.
Deoria						
Misridhara	108	1.7	10	0.83	1	0.50
Kusmauni	100	1.4	-	-	1	0.25
Pakri Babu	92	3.5	23	0.89	6	2.70
Barabanki						
Piprauli	101	2.5	20	1.06	-	-
Fatahabad	84	2.2	27	1.07	3	1.00
Darapur	98	2.8	2	0.37	-	-
Meerut						
Babakpur	105	4.2	2	2.00	-	-
Nagli Isa	90	3.7	6	2.97	-	-
Modkalan	90	5.7	-	-	-	-
Total	868	3.0	90	1.13	11	1.81

Table 2.6 : Details about Leasing Activities by Landholding Size

(Land in acres)

Land Holding Categories	No.of hhs.	Av. land owned per hh.	No.of hhs. leasing in	Av.area leased in per hh.	No.of hhs. leasing out	Av.area leased out per hh.
Marginal						
Less than 1 acre	167	0.6	13	0.40	1	0.50
Small						
1.1 to 2.5 acre	366	1.5	53	0.91	3	1.00
Medium						
2.6 to 5.0 acre	180	3.7	15	1.87	6	2.70
Large						
5.1 to 10.0	124	7.0	7	2.38	1	0.20
Above 10.0	31	15.0	2	1.75	-	-
Total	868	3.0	90	1.13	11	1.81

Table 2.7 : Some Important Economic Characteristics of Households in Sample Villages.

District/ Village	No.of hhs.	Av.Land holding per hh. (Acres)	Av. No. of Parcels per hh.	Av.Size of Parcels (Acres)	Av.No. of Ploughs per hh.	Av.No. of Drought Animals per hh.	Av.Value Improved Agrl. Implements per hh. (Rs.)	Av.Value of Livestock & Poultry per hh. (Rs.)
Deoria								
Misridhara	108	1.54	1.54	1.00	1.0	1.0	603	1758
Kusmauni	100	1.50	2.09	0.72	0.8	0.8	1093	1232
Pakri Babu	92	3.60	3.13	1.15	1.1	1.0	1848	1987
Barabanki								
Piprauli	101	2.71	1.91	1.44	1.0	1.1	2677	2268
Fatehabad	84	2.36	1.83	1.29	1.1	1.0	1671	1982
Darapur	98	2.83	2.02	1.40	1.1	1.3	3440	3555
Meerut								
Babakpur	105	4.21	2.42	1.73	1.6	1.9	6602	6441
Nagli Isa	90	3.96	1.77	2.22	0.9	1.1	2825	3951
Modkalan	90	5.72	2.52	2.26	1.3	2.2	1999	7207
Total	868	3.26	2.13	1.46	1.1	1.3	3593	3364

Table 2.8 : Details about Improved Agricultural Implements in Sample Villages by Landholding Categories.

Landholding Categories (Acres)	Total No. of hhs.	No. of Households Having						Average Value of Improved Agricultural Implements per Households
		Tractor	Tubewells	Pumpset	Thrasher	Chara Cutter	Other Improved Implements	
Marginal								
Less than 1	167	1	1	1	1	52	0	591
Small								
1.1 to 2.5	366	0	9	23	7	183	4	1165
Medium								
2.6 to 5.0	180	2	18	21	25	143	4	4200
Large								
5.1 to 10.0	124	9	25	26	26	109	15	10216
Above 10.0	31	9	6	8	11	25	7	18402
Total	868	21	59	79	70	512	30	3592

Table 2.9 : Some Important Information on Borrowing in Sample Villages

(Rs.'000)

Villages	No. of hhs.	Inst.Agencies		Money Lenders		Other Sources		Av.amt. from all Services per hh.
		No.of borr-owing hhs.	Av.amt. per borrow-ing hh.	No.of borro-wing hhs.	Av.amt. per borrow-ing hh.	No.of borro-wing hhs.	Av.amt. per borrow-ing hh.	
Misridhara	108	75 (69.4)	1.31	46 (42.6)	1.17	5 (4.6)	3.15	1.56
Kusmauni	100	16 (16.0)	0.80	36 (36.0)	1.53	5 (5.0)	0.72	0.71
Pakribabu	92	23 (25.0)	6.94	39 (42.4)	2.19	4 (4.3)	1.18	2.72
Piprauli	101	56 (55.4)	2.03	20 (19.8)	0.96	1 (1.0)	0.40	1.32
Fatehabad	84	20 (23.8)	1.49	16 (19.0)	1.26	1 (1.2)	0.10	0.60
Darapur	98	24 (24.5)	3.66	3 (3.1)	0.87	2 (2.0)	2.15	0.97
Babakpur	105	68 (64.8)	3.53	11 (10.5)	2.70	- -	- -	2.57
Nagli Isa	90	47 (52.2)	1.70	14 (15.5)	2.13	- -	- -	1.22
Modkalan	90	49 (54.4)	3.89	18 (20.0)	2.04	- -	- -	2.52
Total	868	378 (43.55)	2.68	203 (23.4)	1.64	18 (2.1)	1.60	1.58

Note : Figures in parantheses indicate percentages to total number of households in the villages.

Table 2.10 : Some Important Economic Characteristics Related to Cultivation in Sample Villages.

(Land in Acres)

District/ Village	No. of H.Hs.	Net Cropped Area	Gross Cropped Area	Gross Irrig-ated Area	Percentage of Gross Cropped Area in			Total	Cropping Intensity	Gross Irrigated Area as percentage of Gross Cropped Area.
					Kharif	Rabi	Zaidi			
Deoria										
Misridhara	108	166.5	334.7	324.3	48.8	47.5	3.7	100.0	201.0	96.9
Kusmauni	100	150.1	258.7	222.9	51.8	47.6	0.6	100.0	172.3	86.2
Pakri Babu	92	331.4	566.0	434.1	48.4	51.5	0.1	100.0	170.8	77.7
Barabanki										
Piprauli	101	279.6	465.5	446.4	47.1	51.5	1.4	100.0	166.5	95.9
Fatehabad	84	199.0	387.2	354.3	46.3	48.5	5.2	100.0	194.6	91.5
Darapur	98	277.7	448.7	310.0	49.6	49.4	1.0	100.0	161.6	69.1
Meerut										
Babakpur	105	441.8	668.1	656.0	38.0	52.4	9.6	100.0	151.2	98.2
Nagli Isa	90	355.9	531.1	453.0	35.6	58.9	5.5	100.0	149.2	85.3
Modkalan	90	515.0	713.5	589.3	30.6	47.8	21.6	100.0	138.5	82.6
Total	868	2717.1	4373.5	3790.4	42.4	50.9	6.7	100.0	161.0	86.7

Table 2.11 : Important Crops and Cropping Pattern in Sample Villages

District/ Village	Gross Cropped Area (Acres)	Percentage of Gross Cropped Area Under					Name of Third Crop	Other Important Crops
		Paddy	Wheat	Third Crop	Other Crops	Total		
Deoria								
Misridhara	334.7	40.2	43.6	13.2	3.0	(100.0)	Sugercane	Pulses
Kusmauni	258.7	40.8	41.3	5.5	12.4	(100.0)	Sugercane	Pulses
Pakri Babu	566.0	27.8	32.5	8.6	31.1	(100.0)	Maize	Gram, Millet, Pulses
Barabanki								
Piprauli	465.5	35.6	37.4	15.0	12.0	(100.0)	Sugercane	Potato & Poppy
Fatehabad	387.2	30.2	32.5	8.8	28.5	(100.0)	Potato	Poppy, Pulses, Water millon
Darapur	448.7	22.5	33.1	11.3	33.1	(100.0)	Sugercane	Potato, Poppy, Pulses. Water-millon
Meerut								
Babakpur	668.1	6.3	34.7	40.1	18.9	(100.0)	Sugercane	Pulses, Fodder
Nagli Isa	531.1	5.6	39.0	29.7	25.7	(100.0)	Sugercane	Fodder, Pulses
Mod Kalan	713.5	0.2	31.4	38.5	29.9	(100.0)	Sugercane	Fodder, Pulses
Total	4373.5	19.5	35.4	22.0	23.1	(100.0)		

Table 3.1 : Distribution of Households by Type of Irrigation Systems in Sample Villages

District/ Village	Type of Irrigation									
	CNL	STW	PTW	TRD	CNL PTW+	CNL TRD+	STW PTW+	PTW TRD+	Others	Total
Deoria										
Misridhara	92	-	-	5	1	10	-	-	-	108
	(85.2)	-	-	(4.6)	(0.9)	(9.3)	-	-	-	(100.0)
Kusmauni	18	-	8	3	30	23	-	5	13	100
	(18.0)	-	(8.0)	(3.0)	(30.0)	(23.0)	-	(5.0)	(13.0)	(100.0)
Pakri Babu	-	2	25	1	-	-	29	26	9	92
	-	(2.2)	(27.2)	(1.1)	-	-	(31.5)	(28.3)	(9.7)	(100.0)
Barabanki										
Piprauli	61	-	-	4	25	10	-	-	1	101
	(60.4)	-	-	(3.9)	(24.8)	(9.9)	-	-	(1.0)	(100.0)
Fatahbad	10	-	7	6	21	18	-	9	13	84
	(11.9)	-	(8.3)	(7.1)	(25.0)	(21.4)	-	(10.7)	(15.6)	(100.0)
Darapur	1	15	40	-	2	-	35	-	5	98
	(1.0)	(15.3)	(40.8)	-	(2.0)	-	(35.7)	-	(5.2)	(100.0)
Meerut										
Babakpur	46	1	-	-	54	3	-	-	1	105
	(43.8)	(0.9)	-	-	(51.4)	(2.9)	-	-	(1.0)	(100.0)
Nagli Isa	17	-	28	-	37	-	-	-	8	90
	(18.9)	-	(31.1)	-	(41.1)	-	-	-	(8.9)	(100.0)
Modkalan	1	11	16	-	19	-	14	-	29	90
	(1.1)	(12.2)	(17.8)	-	(21.1)	-	(15.6)	-	(32.2)	(100.0)
Total	246	29	124	19	189	64	78	40	79	868
	(28.3)	(3.3)	(14.3)	(2.2)	(21.8)	(7.4)	(9.0)	(4.6)	(9.1)	(100.0)

Note : 1) CNL= Canal, STW= State Tubewell, PTW= Private Tubewell(includes pumpsets), TRD= Traditional OTHS= Others
2) Figures in parenthesis indicate percentages.

Table 3.2 : Details of Irrigation in Sample Villages.

District/ Village	GCA	GIA	Per cent GIA by Different Sources				Total
			CNL	STW	PTW	TRD	
Deoria							
Misridhara	334.7	324.3	88.6	-	4.8	6.6	100.0
Kusmauni	258.7	222.9	47.1	-	34.1	18.8	100.0
Pakri Babu	566.0	434.2	-	0.3	94.2	5.5	100.0
Barabanki							
Piprauli	465.5	446.4	87.7	-	6.5	5.9	100.0
Fatahbad	387.2	354.3	25.8	-	39.7	34.5	100.0
Darapur	448.7	310.0	-	21.7	78.3	-	100.0
Meerut							
Babakpur	668.1	656.0	88.5	-	10.3	1.2	100.0
Nagli Isa	531.1	453.0	59.6	-	40.4	-	100.0
Modkalan	713.5	589.3	17.1	12.2	70.7	-	100.0
Total	4373.5	3790.4	47.2	4.0	42.5	6.3	100.0

Note : GCA= Gross Cultivated Area, GIA= Gross Irrigated Area

Table 3.3 : Distribution of Households by Landholdings in Nine Irrigation Systems

Irrigation Systems	Landholdings (Acres)					Total
	Marginal	Small	Medium	Large		
	Less than 1.00	1.01-2.50	2.51-5.00	5.01-10.00	Above 10	
CNL	86 (51.5)	100 (27.3)	34 (18.9)	20 (16.1)	6 (19.4)	246 (28.3)
STW	9 (5.4)	11 (3.0)	6 (3.3)	1 (0.8)	- -	27 (3.1)
PTW	17 (10.1)	64 (17.5)	24 (13.3)	18 (14.5)	1 (3.2)	124 (14.3)
TRD	6 (3.6)	9 (2.5)	3 (1.7)	1 (0.8)	- -	19 (2.2)
CNL+PTW	12 (7.2)	70 (19.1)	48 (26.7)	50 (40.3)	9 (29.0)	189 (21.8)
CNL+TRD	18 (10.8)	32 (8.7)	12 (6.7)	2 (1.6)	- -	64 (7.4)
STW+PTW	6 (3.6)	31 (8.5)	24 (13.3)	15 (12.1)	4 (12.9)	80 (9.2)
PTW+TRD	4 (2.4)	26 (7.1)	9 (5.0)	1 (0.8)	- -	40 (4.6)
Others	9 (5.4)	23 (6.3)	20 (11.1)	16 (13.0)	11 (35.5)	79 (9.1)
Total	167 (100.0)	366 (100.0)	180 (100.0)	124 (100.0)	31 (100.0)	868 (100.0)

Note : Figures in parenthesis indicate percentages.

Table 3.4 : Details About Improved Agricultural Impliments in Nine Irrigation Systems.

Irrigation Systems	No. of hhs.	No.of H.Hs. having					Av.value of improved Ag. implements per hh.
		Tractor	Tubewell	Pumpset	Thraser	Chare Cutter	
CNL	246	3	-	9	15	124	2051
STW	27	-	-	-	17	17	979
PTW	124	2	23	20	13	77	4497
TRD	19	-	-	1	1	6	105
CNL+PTW	189	6	18	32	19	142	4962
CNL+TRD	64	-	-	-	-	28	217
STW+PTW	80	2	10	17	13	47	3867
PTW+TRD	40	-	-	-	-	14	199
Others	79	8	8	11	9	57	7630
Total	868	21	59	90	70	512	3593

Note : In case of pumpsets 11 hhs. had joint ownership. However in valuing the cost each one's share was taken into account.

Table 3.5 : Details About Area Under Irrigation for Nine Irrigation Systems.

Irrigation Systems	GCA	GIA	Percent GIA by Different Sources				Total
			CNL	STW	PTW	TRD	
CNL	913.6	881.8	100.0	-	-	-	100.0
STW	90.2	89.6	-	100.0	-	-	100.0
PTW	555.8	421.7	-	-	100.0	-	100.0
TRD	55.7	43.2	-	-	-	100.0	100.0
CNL+PTW	1253.1	1161.4	56.0	-	43.4	-	100.0
CNL+TRD	202.4	188.6	53.6	-	46.6	-	100.0
STW+PTW	538.4	409.2	-	9.9	90.1	-	100.0
PTW+TRD	157.4	135.3	-	-	70.2	29.8	100.0
Others	609.9	459.6	19.1	14.3	55.3	11.3	100.0
Total	4373.5	3790.4	47.2	4.0	42.5	6.3	100.0

Note : GCA = Gross Cultivated Area, GIA = Gross Irrigated Area

Table 3.6 : Some Important Economic Characteristics Related to Cultivation in Nine Irrigation Systems.

(area in acres)

Irrigation Systems	No. of hhs.	Net Cropped Area	Net Cropped Area per hh.	G.C.A.	G.I.A.	G.I.A. as per cent of G.C.A.	Cropping Intensity
CNL	246	455.2	2.6	913.6	881.8	96.5	200.7
STW	27	58.7	2.2	90.2	89.6	99.3	153.7
PTW	124	367.0	3.0	555.8	421.7	75.9	151.4
TRD	19	31.3	1.6	55.7	43.2	77.6	177.9
CNL+PTW	189	839.9	4.4	1253.1	1161.4	92.7	149.2
CNL+TRD	64	108.0	1.7	202.4	188.6	93.2	187.4
STW+PTW	80	345.4	4.3	538.4	409.2	76.8	155.9
PTW+TRD	40	90.2	2.3	157.4	135.3	86.0	174.5
Others	79	422.4	5.3	609.9	459.6	75.4	144.4
Total	868	2717.1	3.1	4373.4	3790.4	86.7	161.0

Note : G.C.A.= Gross Cropped Area
G.I.A.= Gross Irrigated Area

Table 3.7 : Modes of Sharing Canal Water in Head-reach and Tail-end Villages

Villages	No.of hhs.	Hhs. using CNL water	Mode of sharing canal water				
			Osaraba-ndi/wara bandi	Upwards to Down-words	No princi-ple/might is right/ cutting the canal	One who starts first allowed to com-plete/ mutual underst-anding	Others
Head-reach Villages :							
1. Misridhara (Gandak)	108	104 (100.0)	-	9 (8.6)	34 (32.7)	60 (57.7)	1 (1.0)
2. Piprauli (Sharda Sahayak)	101	95 (100.0)	90 (94.7)	-	3 (3.2)	-	2 (2.1)
3. Babakpur (Upper Ganga)	105	104 (100.0)	104 (100)	-	-	-	-
Sub-Total	314	303 (100.0)	194 (64.0)	9 (3.0)	37 (12.2)	60 (19.8)	3 (1.0)
Tail-end Villages :							
1. Kusmauni (Gandak)	100	83 (100.0)	-	18 (21.7)	30 (36.1)	32 (38.5)	3 (3.6)
2. Fatehbad (Sharda Sahyak)	84	60 (100.0)	20 (33.3)	11 (18.3)	25 (41.8)	4 (6.6)	-
3. Nagli Isa (Upper Ganga)	90	50 (100.0)	40 (80.0)	-	8 (16.0)	2 (4.0)	-
Sub-Total	274	193 (100.0)	60 (31.1)	29 (15.0)	63 (32.6)	38 (19.7)	3 (1.6)
Total	588	496 (100.0)	254 (51.2)	38 (7.7)	100 (20.2)	98 (19.8)	6 (1.1)

Note : Figures in parenthesis indicate percentages.

Table 3.8 : Modes of Sharing State Tubewell Water.

STW Villages/ Districts	No. of hhs.	No. of hhs. using STW water	No. of hhs. replying	Mode of sharing STW water				
				Osra-bandi/ Wara-bandi	Upward to Down-wards	No Princ-iple due to rare/ irregular electric supply and might is right	One who starts first allowed to take/ mutual unders-tanding	Others
Pakri Babu (Deoria)	92	41	39 (100.0)	- -	5 (12.8)	25 (64.1)	7 (17.9)	2 (5.2)
Darapur (Barabanki)	98	51	50 (100.0)	- -	1 (2.0)	48 (96.0)	- -	1 (2.0)
Modkalan (Meerut)	90	55	47 (100.0)	33 (70.2)	- -	11 (23.4)	2 (4.3)	1 (2.1)
Total	280	147	136 (100.0)	33 (24.3)	6 (4.4)	84 (61.8)	9 (6.6)	4 (2.9)

Note : Figures in parentheses indicate percentages.

Table 3.9 : Modes of Conflict Resolution in Head-Reach and Tail-End Canal Villages

Villages	No. of hhs.	Hhs. CNL water	Modes of Conflict Resolution				
			Mutual reconciliation with or without third party	Approaching Village Pradhan	Might is right	Generally no conflict	Others
Head-reach Villages :							
1. Misridhara (Gandak)	108	104 (100.0)	31 (29.8)	22 (21.2)	13 (12.5)	38 (36.5)	-
2. Piprauli (Sharda Sahayak)	101	95 (100.0)	12 (12.6)	10 (10.5)	22 (23.2)	50 (52.6)	1 (1.1)
3. Babakpur (Upper Ganga)	105	104 (100.0)	22 (21.1)	- -	5 (4.8)	77 (74.1)	-
Sub-Total	314	303 (100.0)	65 (21.4)	32 (10.6)	40 (13.2)	165 (54.5)	1 (0.3)
Tail-end Villages :							
1. Kusmauni (Gandak)	100	83 (100.0)	27 (32.5)	19 (22.9)	24 (28.9)	13 (15.7)	-
2. Fatahabad (Sharda Sahayak)	84	60 (100.0)	15 (25.0)	6 (10.0)	9 (15.0)	30 (50.0)	-
3. Nagli Isa (Upper Ganga)	90	50 (100.0)	24 (48.0)	- -	11 (22.0)	15 (30.0)	-
Sub-Total	274	193 (100.0)	66 (34.2)	25 (12.9)	44 (22.8)	58 (30.1)	-
Total	588	496 (100.0)	131 (26.4)	58 (11.7)	82 (16.5)	223 (45.1)	- 1 (0.2)

Note : Figures in parenthesis indicate percentages.

Table 3.10 : Modes of Conflict Resolution Among State Tubewell Water Users.

STW Villages/ Districts	No. of hhs.	No.of hhs. using STW water	No. of hhs. replying	Mode of Conflict Resolution				
				Mutual reconciliation with or without third party	Thokdar/ Pradhan/ Operator	Might is Right	Generally no conflict	Others
Pakri Babu (Deoria)	92	41	39 (100.0)	8 (20.5)	4 (10.3)	24 (61.5)	3 (7.7)	- -
Darapur (Barabanki)	98	51	50 (100.0)	11 (22.0)	4 (8.0)	6 (12.0)	29 (58.0)	- -
Modkalan (Meerut)	90	55	42 (100.0)	24 (57.1)	- -	2 (4.8)	12 (28.6)	4 (9.5)
Total	280	147	131 (100.0)	43 (32.8)	8 (6.1)	32 (24.4)	44 (33.6)	4 (3.1)

Note : Figures in parantheses indicate percentages

Table 3.11 : Extent of Hiring of Tubewells/Pumpsets in Sample Villages

District/ Village	No. of hhs.	No.of hhs. owning pumpsets	No.of hhs. hiring out pumpsets	No.of hhs. hiring in pumpsets	No.of hhs. owning Tube-well	No.of hhs. hiring out Tubewell	No.of hhs. hiring in Tubewell
Deoria							
Misridhara	108	2	2	-	-	-	-
Kusmauni	100	-	-	5	4	4	41
Pakri Babu	92	9	3	56	4	3	73
Barabanki							
Piprauli	101	9	6	24	-	-	-
Fatahbad	84	14	1	18	1	-	-
Darapur	98	20	5	18	14	1	9
Meerut							
Babakpur	105	15	6	36	1	1	5
Nagli Isa	90	7	-	22	7	2	34
Modkalan	90	3	-	3	28	9	51
Total	868	79	23	182	59	21	213

Table 3.12 : Distribution of Households Owning Pumpsets and Tubewells by Landholding and Source of Finance.

Landholding (Acres)	No. of hhs.	No. hhs. Owning Tubewell	No. hhs. Owning Pumpset	Sources of finance for Pumpset: Own	Bank	Others	Total	Sources of finance for Tubewell: Own	Bank	Others	Total
Marginal											
Less than 1.0	167	1	1	-	1	-	1	1	-	-	1
Small											
1.01 - 2.50	366	9	23	12	10	1	23	7	2	-	9
Medium											
2.51 - 5.00	180	18	21	13	8	-	21	10	7	1	18
Large											
5.01 -10.00	124	25	26	8	18	-	26	14	10	1	25
Above 10.00	31	6	8	3	4	1	8	5	1	-	26
Total	868	59	79	36	41	2	79	37	20	2	59

Table 4.1 : Details about Inputs in Cultivation of Wheat per Acre for Eight Types of Irrigation Systems.

Irrigation Systems	Area under crop (acre)	Average yield qntl./ acre	Use of Seeds(Kg/Acre)			Use of fertiliser(Kg/ Acre)
			Local and Improved local	HYV	Total	
CNL	376.7	8.2	43.8	5.2	49.0	77.6
STW	29.1	7.7	54.8	5.0	59.8	67.4
PTW	195.5	8.2	42.4	9.3	51.7	68.9
TRD	18.7	7.4	54.2	1.6	55.8	38.9
CNL + PTW	422.3	9.3	36.4	13.3	49.7	81.3
CNL + TRD	76.5	8.1	49.8	3.2	53.0	66.9
STW + PTW	178.0	8.0	47.8	5.4	53.2	75.4
PTW + TRD	53.1	7.9	45.7	8.7	54.4	74.6
Total	1350.0	8.3	42.6	8.4	51.0	75.8

Note : 'Others' is excluded.

Table 4.2 : Details about Inputs in Cultivation of Paddy for Seven Types of Irrigation Systems.

Irrigation Systems	Area under crop (acre)	Average yield qntl./ acre	Use of seeds (Kg/Acre)			Use of fertiliser (kg/acre)
			Local and Improved local	HYV	Total	
CNL	251.2	9.2	23.0	1.5	24.5	69.9
PTW	60.4	8.3	19.8	4.5	24.3	65.8
TRD	15.8	7.1	26.6	0.6	27.3	60.9
CNL + PTW	138.3	8.7	24.7	3.3	28.1	75.4
CNL + TRD	65.6	8.0	20.3	0.6	20.8	62.3
STW + PTW	64.9	7.8	25.9	6.5	32.4	69.2
PTW + TRD	41.5	7.0	17.8	9.6	27.4	55.2
Total	637.7	8.8	22.8	3.1	25.9	67.0

Note : 'Others' and 'STW' excluded.

Table 4.3 : Details about Inputs in Cultivation of Sugar Cane for Eight Types of Irrigation Systems.

Irrigation Systems	Area under crop (acre)	Average yield qntl./ acre	Use of Seeds (Kg/Acre)			Average use of fertiliser (Kg/acre)
			Local and Improved local	HYV	Total	
CNL	154.3	159.0	1628.3	162.1	1790.4	125.3
STW	11.7	110.1	1289.8	63.5	1353.3	157.8
PTW	56.4	117.5	1358.1	71.6	1429.7	150.8
TRD	2.0	76.8	1652.0	-	1652.0	47.0
CNL + PTW	286.6	202.5	1750.5	116.5	1867.0	130.1
CNL + TRD	20.8	128.7	1690.5	129.7	1820.2	69.0
STW + PTW	32.7	126.0	1525.4	23.5	1548.9	109.3
PTW + TRD	1.0	104.2	N.A.	N.A.	N.A.	59.4
Total	565.0	172.6	1649.9	117.9	1767.8	127.6

Note : 'Others' is excluded.

Table 4.4 : Adequacy and Regularity Indicies of Canal Water in Head-reach and Tail-end Villages

Villages	Av. Adequacy-Index			Av. Regularity Index		
	Kharif	Rabi	Zaid	Kharif	Rabi	Zaid
Head-reach Vill.						
Misridhara(G)	2.88	2.87	2.89	2.79	2.77	2.81
Piprauli(SS)	2.60	2.51	1.44	2.54	2.46	1.44
Babak Pur(UG)	2.79	2.73	2.65	2.45	2.38	2.39
Sub-Total	2.76	2.70	2.33	2.59	2.52	2.21
Tail-end Vill.						
Kusmauni(G)	2.46	2.45	2.00	2.39	2.37	1.67
Fatehbad(SS)	2.48	2.25	1.00	2.31	2.34	1.00
Nagli Isa(UG)	2.18	2.20	1.83	1.42	2.12	1.40
Sub-Total	2.37	2.30	1.61	2.04	2.28	1.36
TOTAL	2.56	2.50	1.97	2.31	2.40	1.78

Table 4.5 : Reasons for Inadequacy and/or Irregularity of Canal Water in Head-reach and Tail-end Villages

Villages	No. of hhs.	No. of hhs. using canal water	Reasons							
			No. of hhs. responded	Short supply in outlet	Hinderence by upper-reach farmer	Ill maintained canal structures	Plot higher than canal	Field at outlet end	Defective canal structures	Others
Head-reach Village :										
1.Misridhara (Gandak)	108	104	27 (100.0)	2 (7.4)	4 (14.8)	1 (3.7)	4 (14.8)	8 (29.6)	4 (14.8)	4 (14.8)
2.Piprauli (Sharda Sahayak)	101	95	42 (100.0)	26 (61.9)	3 (7.1)	3 (7.1)	- -	10 (23.9)	- -	- -
3.Babakpur (Upper Ganga)	105	104	56 (100.0)	18 (32.1)	20 (35.7)	2 (3.6)	6 (10.7)	9 (16.1)	- -	1 (1.8)
Sub-Total	314	303	125 (100.0)	46 (36.8)	27 (21.6)	6 (4.8)	10 (8.0)	27 (21.6)	4 (3.2)	5 (4.0)
Tail-end Villages:										
1.Kusmauni	100	83	32 (100.0)	8 (25.0)	11 (34.4)	3 (9.4)	8 (25.0)	1 (3.1)	1 (3.1)	- -
2.Fatehabad (Sharda Sahayak)	84	60	33 (100.0)	14 (42.4)	2 (6.1)	9 (27.3)	3 (9.1)	1 (3.0)	3 (9.1)	1 (3.0)
3.Nagli Isa (Upper Ganga)	90	50	40 (100.0)	14 (35.0)	17 (42.5)	5 (12.5)	1 (2.5)	2 (5.0)	- -	1 (2.5)
Sub-Total	274	193	105 (100.0)	36 (34.3)	30 (28.6)	17 (16.2)	12 (11.4)	4 (3.8)	4 (3.8)	2 (1.9)
Total	588	496	230 (100.0)	82 (35.6)	57 (24.8)	23 (10.0)	22 (9.6)	31 (13.5)	8 (3.5	7 (3.0)

Table 4.6 : Adequacy and Regularity Indices of State Tubewell Water in Three Villages.

STW Villages/ Districts	Av. Adequacy Index			Av. Regularity Index		
	Kharif	Rabi	Zaid	Kharif	Rabi	Zaid
Pakri Babu (Deoria)	1.14	1.07	-	1.10	1.07	-
Darapur (Barabanki)	1.40	1.38	1.00	1.13	1.13	1.00
Modkalan	1.30	1.26	1.17	1.30	1.23	1.17
Total	1.29	1.25	1.15	1.18	1.15	1.15

Table 4.7 : Reasons for Inadequacy and/or Irregularity in State Tubewell Irrigation.

STW Villages/ Districts	No. of hhs. using STW water	No. of hhs. respon-ding	Reasons for Inadequacy/Irregularity					
			Irregu-lar/ rare elect-ric supply	Ill maint-ained irrig-ation channels	STW is out of order	Command is larg-er than irriga-tion capacity	No. Elect. /STW is out of order	Others
Pakri Babu (Deoria)	41	21 (100.0)	10 (47.6)	6 (28.6)	3 (14.3)	2 (9.5)	- -	- -
Darapur (Barabanki)	51	43 (100.0)	1 (2.3)	1 (2.3)	24 (55.8)	2 (4.7)	15 (34.9)	- -
Modkalan (Meerut)	55	41 (100.0)	29 (70.7)	6 (14.6)	- -	- -	1 (2.4)	5 (12.3)
Total	147	105 (100.0)	40 (38.1)	13 (12.4)	27 (25.7)	4 (3.8)	16 (15.2)	5 (4.8)

Table 4.8 : Opinion about Assessment in Head-reach and Tail-end Villages.

Villages	No.of hhs.	No.of hhs using canal water	No.of hhs respo-nding	Openions		
				Generally incorrect	Sometimes incorrect	Generally Correct
Head-reach Vill. :						
Misridhara(G)	108	104	104 (100.0)	11 (10.6)	25 (24.0)	68 (65.4)
Piprauli(SS)	101	95	85 (100.0)	14 (16.5)	7 (8.2)	64 (75.3)
Babak Pur(UG)	105	104	103 (100.0)	20 (19.4)	30 (29.1)	53 (51.5)
Sub-Total	314	303	292 (100.0)	45 (15.4)	62 (21.2)	185 (63.4)
Tail-end Vill:						
Kusmauni(G)	100	83	83 (100.0)	17 (20.5)	32 (38.5)	34 (41.0)
Fatehbad(SS)	84	60	60 (100.0)	6 (10.0)	12 (20.0)	42 (70.0)
Nagli Isa(UG)	90	50	46 (100.0)	14 (30.4)	12 (26.1)	20 (43.5)
Sub-Total	274	193	189 (100.0)	37 (19.6)	56 (29.6)	96 (50.8)
Total	588	496	481 (100.0)	82 (17.0)	118 (24.5)	281 (58.5)

Table 4.9 : Opinion about Assessment Among State Tubewell Water Users.

STW Villages/ Districts	No of hhs. using STW water	No.of hhs. responding	Openion		
			Generally incorrect	Sometimes incorrect	Generally Correct
Pakri Babu (Deoria)	41	28 (100.0)	8 (28.6)	20 (71.4)	-
Darapur (Barabanki)	51	50 (100.0)	9 (18.0)	10 (20.0)	31 (62.0)
Modkalan (Meerut)	55	44 (100.0)	12 (27.3)	14 (31.8)	18 (40.9)
Total	147	122 (100.0)	29 (23.8)	44 (36.1)	49 (40.1)

Table 4.10 : Problems Faced in Delevery of Canal Water by the Households in Head-reach and Tail-end Villages

Village	No. of hhs.	No. of hhs. using canal water	No. of hhs. responded	Problems faced in the delevary of water				
				Breaking of structures and illegal diversion of water	Defective canal structures	Very inadequate/irregular supply of water	Others	No Problem
Head reach Villages:								
1.Misridhara (Gandak)	108	104	103 (100.0)	5 (4.9)	7 (6.8)	6 (5.8)	2 (2.0)	83 (80.5)
2.Piprauli (Sharda Sahayak)	101	95	91 (100.0)	1 (1.1)	4 (4.4)	19 (20.9)	- -	67 (73.6)
3.Babakpur (Upper Ganga)	105	104	96 (100.0)	12 (12.5)	- -	24 (25.0)	2 (2.1)	58 (60.4)
Sub-Total	314	303	290 (100.0)	18 (6.2)	11 (3.8)	49 (16.9)	4 (1.4)	208 (71.7)
Tail reach Villages:								
1.Kusmauni (Gandak)	100	83	80 (100.0)	4 (4.9)	14 (17.6)	19 (23.7)	8 (10.2)	35 (43.6)
2.Fatahabad (Sharda Sahayak)	84	60	60 (100.0)	9 (15.0)	5 (8.3)	12 (20.0)	3 (5.0)	31 (51.7)
3.Nagli Isa (Upper Gandak)	90	50	50 (100.0)	6 (12.0)	1 (2.0)	16 (32.0)	5 (10.0)	22 (44.0)
Sub-Total	274	193	190 (100.0)	19 (10.0)	20 (10.5)	47 (24.7)	16 (18.5)	88 (46.3)
TOTAL	588	496	480 (100.0)	37 (7.7)	31 (6.5)	96 (20.0)	20 (4.1)	296 (61.7)

Table 4.11 : Problem Faced in Delevery of State Tubewell Water by the User Households.

STW Villages/ Districts	No. hhs. using STW water	No. of hhs. respon-ding	Problem faced in delevery of water					
			Bad condition of irrig-ation channels	Plot far off from STW	Rare supply of elect-ricity	STW is out of order	STW out of order/ electri-city not available	Others
Pakri Babu (Deoria)	41	35 (100.0)	18 (51.5)	9 (25.7)	- -	5 (14.3)	3 (8.6)	- -
Darapur (Barabanki)	51	43 (100.0)	3 (7.0)	- -	3 (7.0)	23 (53.5)	14 (32.5)	- -
Modkalan (Meerut)	55	46 (100.0)	5 (10.9)	2 (4.3)	28 (60.9)	- -	6 (13.0)	5 (10.9)
Total	147	124 (100.0)	26 (21.0)	11 (8.9)	31 (25.0)	28 (22.6)	23 (18.5)	5 (4.0)

Table 4.12 : Agency/Officials Approached for Rectifying Canal Problems in Head-reach and Tail-end Villages

Villages	No.of hhs.	No.of hhs. using canal water	No.of hhs. replied	Agency/Officials Approached for Rectification					
				Patrol	Oversear/ Ziladar	SDO	Executive Engineer	Others	Did not Approach
Head reach Villages :									
1.Misridhara (Gandak)	108	104	20 (100.0)	5 (25.0)	- -	- -	- -	1 (5.0)	14 (70.0)
2.Piprauli (Sharda Sahayak)	101	95	29 (100.0)	1 (3.4)	- -	3 (10.3)	1 (3.4)	3 (10.3)	21 (72.6)
3.Babakpur (Upper Ganga)	105	104	38 (100.0)	1 (2.6)	1 (2.6)	- -	2 (5.3)	1 (12.6)	33 (86.9)
Sub-Total	314	303	87 (100.0)	7 (8.0)	1 (1.1)	3 (3.4)	3 (3.4)	5 (5.9)	68 (78.2)
Tail reach Villages :									
1.Kusmauni (Gandak)	100	83	43 (100.0)	8 (18.6)	3 (7.0)	3 (7.0)	6 (13.8)	4 (21.5)	19 (44.1)
2.Fatehabad (Sarda Sahayak)	84	60	29 (100.0)	3 (10.3)	1 (3.4)	- -	9 (31.0)	2 (7.0)	14 (48.3)
3.Nagli Isa (Upper Ganga)	90	50	28 (100.0)	2 (7.2)	5 (17.7)	1 (3.6)	4 (14.3)	2 (7.2)	14 (50.0)
Sub-Total	274	193	100 (100.0)	13 (13.0)	9 (9.0)	4 (4.0)	19 (19.0)	8 (8.0)	47 (47.0)
TOTAL	588	496	187 (100.0)	20 (10.7)	10 (5.3)	7 (3.7)	22 (11.8)	13 (7.0)	115 (61.5)

Table 4.13 : Outcome of Agency/Officials Approached for Rectifying Canal Problems in Head-reach adn Tail-end Villages

Villages	No. of hhs.	No. of hhs using canal water	hhs approached	Outcome		
				Problem solved by officials efforts.	Official made efforts but problems not solved	No help was rendered
Head_reach Villages :						
1.Misridhara (Gandak)	108	104	6 (100.0)	-	-	6 (100)
2.Piprauli (Sharda Sahayak)	101	95	8 (100.0)	-	-	8 (100)
3.Babakpur (Upper Ganga)	105	104	5 (100.0)	-	-	5 (100)
Sub-Total	314	303	19 (100.0)	-	-	19 (100)
Tail-end Villages :						
1.Kusmauni (Gandak)	100	83	24 (100.0)	1 (4.2)	2 (8.4)	21 (87.4)
2.Fatahabad (Sharda Sahayak)	84	60	15 (100.0)	-	-	15 (100)
3.Nagli Isa (Upper Ganga)	90	50	14 (100.0)	-	1 (7.1)	13 (92.9)
Sub-Total	274	193	53 (100.0)	1 (1.8)	3 (5.4)	49 (92.8)
TOTAL	588	496	72 (100.0)	1 (1.4)	3 (4.2)	68 (94.4)

Table 4.14 : Agency/Officials Approached for Rectifying Problems Related to State Tubewell Irrigation.

STW Villages/ Districts	No. of hhs. using STW water	No.of hhs. respon-ding	Agency/Offls. apprd.for Rectification					Did not approach
			Opera-tor/ Amin	Ziladar	SDO	Execu-tive Engin-eer	Others	
Pakri Babu (Deoria)	41	39 (100.0)	10 (25.6)	1 (2.6)	- -	1 (2.26)	3 (7.7)	24 (61.5)
Darapur (Barabanki)	51	47 (100.0)	17 (36.2)	- -	- -	2 (4.3)	- -	28 (59.5)
Modkalan (Meerut)	55	42 (100.0)	3 (7.1)	- -	- -	3 (7.1)	1 (2.4)	35 (83.4)
TOTAL	147	128 (100.0)	30 (23.4)	1 (0.8)	- -	6 (4.7)	4 (3.1	87 (68.0)

Table 4.15 : Outcome of Agency/Officials Approached for Rectifying State Tubewell Irrigation Problems.

STW Villages/ Districts	No. of hhs.	No.of hhs appre-ached	Outcome		
			Problem solved by offi-cial efforts.	Official made eff-ort but problem was not solved	No. help was rendered
Pakri Babu (Deoria)	41	15 (100.0)	- -	3 (20.0)	12 (80.0)
Darapur (Barabanki)	51	19 (100.0)	- -	- -	19 (100.0)
Modkalan (Meerut)	55	7 (100.0)	- -	1 (14.3)	6 (85.7)
TOTAL	147	41 (100.0)	- -	4 (9.8)	37 (90.2)

Table 4.16 : Knowledge of the Offices of Different Canal and CADA Officials.

Office of	Percentage of Users Knowing the Office					
	Gandak Deoria		Sharda Sahayak Barabanki		Upper Ganga* Meerut	
	Misridhara	Kusmauni	Piprauli	Fateh-abad	Babak-pur	Nagli-Isa
Canal :						
Ex.Engineer	8.7	41.0	13.7	31.7	41.4	36.0
Asstt.Engineer	29.6	31.0	14.8	23.8	36.2	30.0
Jr.Engineer	34.3	28.0	10.9	14.3	21.9	21.1
Dy.Revenue Officer	5.6	9.0	3.9	4.8	18.1	32.2
Ziladar	25.0	18.0	10.9	17.2	32.4	25.6
CADA :						
Soil Conservation Officer	16.7	9.0	11.9	11.9	-	-
Soil Conservation Inspector	13.9	7.0	4.9	1.2	-	-
Asstt.Soil Conservation Inspector	5.6	2.0	0.9	1.2	-	-
	N=108	N=100	N=101	N=84	N=105	N=90

*Not covered under Command Area Development Programme.

Table 4.17 : Evaluation of Field Level Officials of Canal

Evaluation of	Percentage of Users Evaluating the Officials					
	Gandak Deoria		Sharda Sahayak Barabanki		Upper Ganga Meerut	
	Misridhara	Kusmauni	Piprauli	Fateh-abad	Babak-pur	Nagli Isa
Canal :						
Amin - Bad	6.5	4.0	9.9	4.8	18.1	11.1
Fair	15.7	16.0	28.7	17.9	11.4	8.9
Good	17.6	2.0	38.6	21.4	66.7	34.4
Don't Know	60.2	78.0	22.8	55.9	3.8	45.6
Patrol-Bad	28.7	38.0	25.7	21.4	48.6	28.9
Fair	29.6	34.0	28.7	21.4	7.6	7.8
Good	28.7	8.0	41.6	25.0	40.9	22.2
Don't Know	13.0	20.0	4.0	32.2	2.9	41.1
	N=108	N=100	N=101	N=84	N=105	N=90

Table 4.18 : Knowledge of the Offices of Different Officials of State Tubewell

Office of	Percentage of Users Knowing the Office		
	Deoria	Barabanki	Meerut
	Pakri Babu	Darapur	Mod Kalan
Ex.Engineer	48.8	17.7	21.8
Asstt.Engineer	48.8	15.7	27.4
Jr.Engineer	29.3	11.8	13.7
Dy.Revenue Officer (DRO)	7.3	3.9	11.8
Ziladar	14.6	9.8	13.7
	N=41	N=51	N=55

Table 4.19 : Evaluation of Field Level State Tubewell Officials.

Evaluation of	Percentage of Users Evaluating the Officials		
	Deoria	Barabanki	Meerut
	Pakri Babu	Darapur	Mod Kalan
Amin :			
Bad	22.2	11.0	11.1
Fair	10.9	10.0	3.3
Good	3.3	1.0	22.2
Don't Know	63.6 (100.0)	78.0 (100.0)	63.4 (100.0)
Operator :			
Bad	16.3	19.4	31.1
Fair	20.6	14.3	2.2
Good	3.3	19.4	16.7
Don't Know	59.8 (100.0)	48.9 (100.0)	50.0 (100.0)
	N=41	N=51	N=55

Table 4.20 : Suggestions Offered for Better Utilization of Canal Irrigation in Head-reach and Tail-end Villages

Villages	No. of hhs.	No. of hhs. replying	Suggestions Offered								
			Proper maintenance of canal structures	Arrangement of control structures.	Providing field channels	Work sincerity of staff	Punishment for guilty farmers	Irrigation down to upward	Closer proximity between command and outlet capacity	Others	No Idea
Head-reach Villages :											
1.Misridhara (Gandak)	108	104 (100.0)	5 (4.8)	3 (2.9)	4 (3.8)	4 (3.8)	-	-	-	5 (4.8)	83 (79.9)
2.Piprauli (Sharda Sahayak)	101	95 (100.0)	2 (2.1)	2 (2.1)	2 (2.1)	1 (1.0)	1 (1.0)	-	3 (3.2)	7 (7.4)	77 (81.1)
3.Babakpur (Upper Ganga)	105	104 (100.0)	2 (1.9)	3 (2.9)	14 (13.5)	11 (10.6)	2 (1.9)	-	14 (13.5)	8 (7.7)	50 (48.0)
Sub-Total	314	303 (100.0)	9 (3.0)	8 (2.6)	20 (6.6)	16 (5.3)	3 (1.0)	-	17 (5.6)	20 (6.6)	210 (69.3)
Tailend Villages :											
1.Kusmauni (Gandak)	100	83 (100.0)	5 (6.0)	13 (15.7)	14 (16.9)	6 (7.2)	1 (1.2)	-	-	5 (6.0)	39 (47.0)
2.Fatehabad (Sharda Sahayak)	84	60 (100.0)	4 (6.7)	5 (8.3)	12 (20.0)	2 (3.3)	-	-	-	2 (3.3)	35 (58.4)
3.Nagli Isa (Upper Ganga)	90	50 (100.0)	4 (8.0)	1 (2.0)	- -	7 (14.0)	5 (10.0)	-	7 (14.0)	14 (28.0)	12 (24.0)
Sub-Total	274	193 (100.0)	13 (6.7)	19 (9.8)	26 (13.5)	15 (7.8)	6 (3.1)	-	7 (3.6)	21 (10.9)	86 (44.6)
TOTAL	588	496 (100.0)	22 (4.4)	27 (5.4)	46 (9.3)	31 (6.3)	9 (1.8)	-	24 (4.8)	41 (8.3)	296 (59.7)

Table 4.21 : Suggestions Offered for Better Utilization of State Tubewell by the User Households.

STW Villages/ Districts	No. of hhs.	No.of hhs. offered suggestions	Suggestions Offered: More regular electric supply	Repair and proper maintenance of irrigation channels	Work sincerity of staff	Others	No Idea
Pakri Babu (Deoria)	41	33 (100.0)	6 (18.2)	9 (27.3)	3 (9.1)	2 (6.0)	13 (39.4)
Darapur (Barabanki)	51	51 (100.0)	3 (5.9)	20 (39.2)	1 (2.0)	- -	27 (52.9)
Modkalan (Meerut)	55	49 (100.0)	17 (34.7)	8 (16.3)	3 (6.1)	2 (4.1)	19 (38.8)
TOTAL	147	133 (100.0)	26 (19.5)	37 (27.8)	7 (5.3)	4 (3.0)	59 (44.4)

Table 4.22 : Landholding-wise Area Irrigated by Purely Public Irrigation Systems.
(Area in Acres)

Landholding (Acres)	No.of hhs.	Total Area Irrigated by Canal	Total Area Irrigated by STW	Total area Irrigated by Purely Public Irrigation System (CNL+STW)	Av.Area Irrigated by purely Public Irrigation Systems per hh.
Marginal (Less than 1.00)	167 (19.2)	128.7 (7.3)	21.3 (13.5)	150.0 (7.8)	0.9
Small (1.01-2.50)	366 (42.2)	435.6 (24.8)	20.8 (13.1)	456.4 (23.9)	1.2
Medium (2.51-5.00)	180 (20.7)	422.9 (24.1)	58.2 (36.8)	481.1 (25.2)	... 2.7
Large (5.01-10.00	124 (14.3)	499.1 (28.5)	34.7 (21.9)	533.8 (27.9)	4.3
Above 10.00	31 (3.6)	267.0 (15.3)	23.3 (14.7)	290.3 (15.2)	9.4
TOTAL	868 (100.0)	1753.3 (100.0)	158.3 (100.0)	1911.6 (100.0)	2.2

Figures in parentheses indicate percentages.

Table 4.23 : Caste-wise Area Irrigated by Purely Public Irrigation Systems.

(Area in acres)

Caste	No.of hhs. irrig-ating	Total area Irrig-ated by canal	Total area Irrig-ated by STW	Total area Irrig-ated by purely Public Irri-gation Systems (CNL+STW)	Av.area Irrigated by purely Pub-lic Irriga-tion Systems per hh.
1.Brahmin	46 (5.3)	170.0 (9.7)	- (0.0)	170.0 (8.9)	3.7
2.Rajput/Bhumihar	96 (11.1)	311.6 (17.8)	4.8 (3.0)	316.4 (16.5)	3.3
3.Jat/Gujjar	138 (15.9)	391.0 (22.3)	78.3 (49.5)	469.3 (24.6)	3.4
4.Yadav,Koiri, Kurmi	262 (30.2)	481.0 (27.4)	61.6 (38.9)	542.6 (28.4)	2.1
5.Other Backward Castes	96 (11.1)	119.3 (6.8)	5.8 (3.7)	125.1 (6.5)	1.3
6.Scheduled Castes	220 (25.3)	267.0 (15.2)	7.8 (4.9)	274.8 (14.4)	1.2
7.Muslim	10 (1.1)	13.4 (0.8)	- (0.0)	13.4 (0.7)	1.3
TOTAL	868 (100.0)	1753.3 (100.0)	158.3 (100.0)	1911.6 (100.0)	2.2

Figures in parantheses indicate percentages.

Table 4.24 : Details About Private Irrigation (Tubewell and Pumpset) in Sample Villages.

District/ Village	No. of hhs.	No. of hhs. owning PTW/PS	Per cent of hhs. owning PTW/PS	No. of hhs. Irrig-ating through PTW/PS	No. of users per PTW/PS	Area Irriga-ted (Acres)	Area Irriga-ted per PTW/PS
Deoria :			6.3				
Misridhara	108	2	1.9	2	1.0	18.0	9.0
Kusmauni	100	4	4.0	54	13.5	78.7	19.7
Pakri Babu	92	13	14.1	92	7.1	352.1	27.1
Barabanki :			20.5				
Piprauli	101	9	8.9	32	3.6	29.0	3.2
Fatahabad	84	15	17.9	56	3.7	137.5	9.2
Darapur	98	34	34.7	79	2.3	233.4	6.9
Meerut :			21.4				
Babakpur	105	16	15.2	55	3.4	50.6	3.2
Nagli Isa	90	14	15.5	67	4.8	214.2	15.3
Modkalan	90	31	34.4	80	2.6	497.7	16.1
Total	868	138	15.9	517	3.7	1611.2	11.7

Table 4.25 : Details About Running Cost of the Private Tubewell by Landholding Groups

Landholding (In acres)	Total area irrig-ated by pri-vate Tubewell	Per acre annual running cost on (Rs.)			
		Fuel	Mainte-nance	Operation	Total
Marginal (Less than 1.0)	26.8	188.7	48.6	-	237.3
Small (1.1 to 2.5)	352.9	169.0	36.5	-	205.5
Medium (2.51 to 5.0)	409.0	104.3	28.7	4.4	137.4
Large (5.01 to 10.0	594.0	103.2	27.6	-	130.8
(Above 10.0)	228.6	83.3	19.0	3.7	106.0
TOTAL	1611.2	94.6	24.6	1.6	120.8

Table 4.26 : Difficulties Faced Regarding Fuel and Electricity for Private Tubewells/ Pumpsets in Sample Villages.

District/ Village	No.of hhs.	No.of hhs. owning PTW/PS	Difficulties		No Difficulty
			Scarcity of diesel/diesel available at remote places	Rare/irregular supply of electricity	
Deoria :					
Misridhara	108	2	1	-	1
Kusmauni	100	4	1	3	-
Pakri Babu	92	13	8	2	3
Barabanki :					
Piprauli	101	9	5	-	4
Fatahabad	84	15	10	3	2
Darapur	98	34	13	16	5
Meerut :					
Babakpur	105	16	2	14	-
Nagli Isa	90	14	4	9	1
Modkalan	90	31	5	26	-
TOTAL	868	138	49	73	16

Table 4.27 : Details of area Irrigated by Traditional Irrigation Systems in Sample Villages.

District/ Village	No.of hhs.Using		Area Irrigated (acres)	Av.area Irrigated per hh. (acres)	Av.hour required per acre
	Rahat	Dhekuli/ Dhekueha			
Deoria :					
Misridhara	-	7	13.0	1.9	66.5
Kusmauni	-	43	43.4	1.0	59.3
Pakri Babu	-	35	19.7	.6	60.7
Barabanki :					
Piprauli	10	-	20.5	2.1	30.2
Fatahabad	45	-	116.2	2.6	25.5
Darapur	-	-	-	-	-
Meerut :					
Babakpur	-	3	6.0	2.0	61.5
Nagli Isa	-	-	-	-	-
Modkalan	-	-	-	-	-
TOTAL	55	88	218.7	1.5	50.6